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THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

SCIENCE AS SUBJECT-MATTER AND AS METHOD[1]

ONE who, like myself, claims no expertness in any branch of natural science can undertake to discuss the teaching of science only at some risk of presumption. At present, however, the gap between those who are scientific specialists and those who are interested in science on account of its significance in life, that is to say, on account of its educational significance, is very great. Therefore I see no other way of promoting that mutual understanding so requisite for educational progress than for all of us frankly to state our own convictions, even if thereby we betray our limitations and trespass where we have no rights save by courtesy.

I suppose that I may assume that all who are much interested in securing for the sciences the place that belongs to them in education feel a certain amount of disappointment at the results hitherto attained. The glowing predictions made respecting them have been somewhat chilled by the event. Of course, this relative shortcoming is due in part to the unwillingness of the custodians of educational traditions and ideals to give scientific studies a fair show. Yet in view of the relatively equal opportunity accorded to science to-day compared with its status two generations ago, this cause alone does not explain the unsatisfactory outcome. Considering the oppor-

[1] Address of the vice-president and chairman of Section L, Education, American Association for the Advancement of Science, Boston, 1909.

tunities, students have not flocked to the study of science in the numbers predicted, nor has science modified the spirit and purport of all education in a degree commensurate with the claims made for it. The causes for this result are many and complex. I make no pretense of doing more than singling out what seems to me one influential cause, the remedy for which most lies with scientific men themselves. I mean that science has been taught too much as an accumulation of ready-made material with which students are to be made familiar, not enough as a method of thinking, an attitude of mind, after the pattern of which mental habits are to be transformed.

Among the adherents of a literary education who have contended against the claims of science, Matthew Arnold has, I think, been most discreetly reasonable. He freely admitted the need of men knowing something, knowing a good deal, about the natural conditions of their own lives. Since, so to say, men have to breathe air, it is advisable that they should know something of the constitution of air and of the mechanism of the lungs. Moreover, since the sciences have been developed by human beings, an important part of humanistic culture, of knowing the best that men have said and thought, consists in becoming acquainted with the contributions of the great historic leaders of science.

These concessions made, Matthew Arnold insisted that the important thing, the indispensable thing in education, is to become acquainted with human life itself, its art, its literature, its politics, the fluctuations of its career. Such knowledge, he contended, touches more closely our offices and responsibilities as human beings, since these, after all, are to human beings and not to physical things. Such knowledge, moreover, lays hold of the emotions and the imagination and modifies character, while knowledge about things remains an inert possession of speculative intelligence.

Those who believe, nevertheless, that the sciences have a part to play in education equal—at the least—to that of literature and language, have perhaps something to learn from this contention. If we regard science and literary culture as just so much subject-matter, is not Mr. Arnold's contention essentially just? Conceived from this standpoint, knowledge of human affairs couched in personal terms seems more important and more intimately appealing than knowledge of physical things conveyed in impersonal terms. One might well object to Arnold that he ignored the place of natural forces and conditions *in* human life and thereby created an impossible dualism. But it would not be easy to deny that knowledge of Thermopylæ knits itself more readily into the body of emotional images that stir men to action than does the formula for the acceleration of a flying arrow; or that Burns's poem on the daisy enters more urgently and compellingly into the moving vision of life than does information regarding the morphology of the daisy.

The infinitely extensive character of natural facts and the universal character of the laws formulated about them is sometimes claimed to give science an advantage over literature. But viewed from the standpoint of education, this presumed superiority turns out a defect; that is to say, so long as we confine ourselves to the point of view of subject-matter. Just because the facts of nature are multitudinous, inexhaustible, they begin nowhere and end nowhere in particular, and hence are not, just as facts, the best material for the education of those whose lives are centered in quite local situations and whose careers are irretrievably partial and specific. If we

turn from multiplicity of detail to general laws, we find indeed that the laws of science are universal, but we also find that for educational purposes their universality means abstractness and remoteness. The conditions, the interests, the ends of conduct are irredeemably concrete and specific. We do not live in a medium of universal principles, but by means of adaptations, through concessions and compromises, struggling as best we may to enlarge the range of a concrete here and now. So far as acquaintance is concerned, it is the individualized and the humanly limited that helps, not the bare universal and the inexhaustibly multifarious.

These considerations are highly theoretical. But they have very practical counterparts in school procedure. One of the most serious difficulties that confronts the educator who wants in good faith to do something worth while with the sciences is their number, and the indefinite bulk of the material in each. At times, it seems as if the educational availability of science were breaking down because of its own sheer mass. There is at once so much of science and so many sciences that educators oscillate, helpless, between arbitrary selection and teaching a little of everything. If any questions this statement, let him consider in elementary education the fortunes of nature-study for the last two decades.

Is there anything on earth, or in the waters under the earth or in the heavens above, that distracted teachers have not resorted to? Visit schools where they have taken nature study conscientiously. This school moves with zealous bustle from leaves to flowers, from flowers to minerals, from minerals to stars, from stars to the raw materials of industry, thence back to leaves and stones. At another school you find children energetically striving to keep up with what is happily termed the "rolling year." They chart the records of barometer and thermometer; they plot changes and velocities of the winds; they exhaust the possibilities of colored crayons to denote the ratio of sunshine and cloud in successive days and weeks; they keep records of the changing heights of the sun's shadows; they do sums in amounts of rainfalls and atmospheric humidities—and at the end, the rolling year, like the rolling stone, gathers little moss.

Is it any wonder that after a while teachers yearn for the limitations of the good old-fashioned studies—for English grammar, where the parts of speech may sink as low as seven but never rise above nine; for text-book geography, with its strictly inexpansive number of continents; even for the war campaigns and the lists of rulers in history since they can not be stretched beyond a certain point, and for "memory gems" in literature, since a single book will contain the "Poems Every Child Should Know."

There are many who do not believe it amounts to much one way or the other what children do in science in the elementary school. I do not agree, for upon the whole, I believe the attitude toward the study of science is, and should be, fixed during the earlier years of life. But in any case, how far does the situation in the secondary schools differ from that just described? Any one who has followed the discussions of college faculties for the last twenty-five years concerning entrance requirements in science, will be able to testify that the situation has been one of highly unstable equilibrium between the claims of a little of a great many sciences, a good deal (comparatively) of one, a combination of one biological and one exact science, and the arbitrary option of the pupil of one, two or three out of a list of six or seven specified sciences.

The only safe generalization possible is that whatever course a given institution pursues, it changes that course at least as often as the human organism proverbially renews its tissues. The movement has probably tended in the direction of reduction, but every one who has followed the history of pedagogical discussion will admit that every alteration of opinion as to what subjects should be taught has been paralleled by a modification of opinion as to the portions of any subject to be selected and emphasized.

All this change is to some extent a symptom of healthy activity, change being especially needed in any group of studies so new that they have to blaze their own trail, since they have no body of traditions upon which to fall back as is the case with study of language and literature. But this principle hardly covers the whole field of change. A considerable part of it has been due not to intelligent experimentation and exploration, but to blind action and reaction, or to the urgency of some strenuous soul who has propagated some emphatic doctrine.

Imagine a history of the teaching of the languages which should read like this: "The later seventies and early eighties of the nineteenth century witnessed a remarkable growth in the attention given in high schools to the languages. Hundreds of schools adopted an extensive and elaborate scheme by means of which almost the entire linguistic ground was covered. Each of the three terms of the year was devoted to a language. In the first year, Latin and Greek and Sanskrit were covered; in the next, French, German and Italian; while the last year was given to review and to Hebrew and Spanish as optional studies."

This piece of historic parallelism raises the question as to the real source of the educational value of, say, Latin. How much is due to its being a "humanity," its giving insight into the best the world has thought and said, and how much to its being pursued continuously for at least four years? How much to the graded and orderly arrangement that this long period both permitted and compelled? How much to the cumulative effort of constant recourse to what had earlier been learned, not by way of mere monotonous repetition, but as a necessary instrument of later achievement? Are we not entitled to conclude that the method demanded by the study is the source of its efficacy rather than anything inhering in its content?

Thus we come around again to the primary contention of the paper: that science teaching has suffered because science has been so frequently presented just as so much ready-made knowledge, so much subject-matter of fact and law, rather than as the effective method of inquiry into any subject-matter.

Science might well take a leaf from the book of the actual, as distinct from the supposititious, pursuit of the classics in the schools. The claim for their worth has professedly rested upon their cultural value; but imaginative insight into human affairs has perhaps been the last thing, save *per accidens,* that the average student has got from his pursuit of the classics. His time has gone of necessity to the mastering of a language, not to appreciation of humanity. To some extent just because of this enforced simplification (not to say meagerness) the student acquires, if he acquires anything, a certain habitual method. Confused, however, by the tradition that the subject-matter is the efficacious factor, the defender of the sciences has thought that he could make good his case only on analogous grounds, and hence has been misled into resting his claim upon the superior significance of his special subject-matter;

even into efforts to increase still further the scope of scientific subject-matter in education. The procedure of Spencer is typical. To urge the prerogative of science, he raised the question what knowledge, what facts, are of most utility for life, and, answering the question by this criterion of the value of subject-matter, decided in favor of the sciences. Having thus identified education with the amassing of information, it is not a matter of surprise that for the rest of his life he taught that comparatively little is to be expected from education in the way of moral training and social reform, since the motives of conduct lie in the affections and the aversions, not in the bare recognition of matters of fact.

Surely if there is any knowledge which is of most worth it is knowledge of the ways by which anything is entitled to be called knowledge instead of being mere opinion or guess-work or dogma.

Such knowledge never can be learned by itself; it is not information, but a mode of intelligent practise, an habitual disposition of mind. Only by taking a hand in the making of knowledge, by transferring guess and opinion into belief authorized by inquiry, does one ever get a knowledge of the method of knowing. Because participation in the making of knowledge has been scant, because reliance on the efficacy of acquaintance with certain kinds of facts has been current, science has not accomplished in education what was predicted for it.

We define science as systematized knowledge, but the definition is wholly ambiguous. Does it mean the body of facts, the subject-matter? Or does it mean the processes by which something fit to be called knowledge is brought into existence, and order introduced into the flux of experience? That science means both of these things will doubtless be the reply, and rightly. But in the order both of time and of importance, science as method precedes science as subject-matter. Systematized knowledge is science only because of the care and thoroughness with which it has been sought for, selected and arranged. Only by pressing the courtesy of language beyond what is decent can we term such information as is acquired ready-made, without active experimenting and testing, science.

The force of this assertion is not quite identical with the commonplace of scientific instruction that text-book and lecture are not enough; that the student must have laboratory exercises. A student may acquire laboratory methods as so much isolated and final stuff, just as he may so acquire material from a text-book. One's mental attitude is not necessarily changed just because he engages in certain physical manipulations and handles certain tools and materials. Many a student has acquired dexterity and skill in laboratory methods without its ever occurring to him that they have anything to do with constructing beliefs that are alone worthy of the title of knowledge. To do certain things, to learn certain modes of procedure, are to him just a part of the subject-matter to be acquired; they belong, say, to chemistry, just as do the symbols H_2SO_4 or the atomic theory. They are part of the arcana in process of revelation to him. In order to proceed in the mystery one has, of course, to master its ritual. And how easily the laboratory becomes liturgical! In short, it is a problem and a difficult problem to conduct matters so that the technical methods employed in a subject shall become conscious instrumentalities of realizing the meaning of knowledge —what is required in the way of thinking and of search for evidence before anything

passes from the realm of opinion, guess work and dogma into that of knowledge. Yet unless this perception accrues, we can hardly claim that an individual has been instructed in science. This problem of turning laboratory technique to intellectual account is even more pressing than that of utilization of information derived from books. Almost every teacher has had drummed into him the inadequacy of mere book instruction, but the conscience of most is quite at peace if only pupils are put through some laboratory exercises. Is not this the path of experiment and induction by which science develops?

I hope it will not be supposed that, in dwelling upon the relative defect and backwardness of science teaching I deny its absolute achievements and improvements, if I go on to point out to what a comparatively slight extent the teaching of science has succeeded in protecting the so-called educated public against recrudescences of all sorts of corporate superstitions and silliness. Nay, one can go even farther and say that science teaching not only has not protected men and women who have been to school from the revival of all kinds of occultism, but to some extent has paved the way for this revival. Has not science revealed many wonders? If radio-activity is a proved fact, why is not telepathy highly probable? Shall we, as a literary idealist recently pathetically inquired, admit that mere brute matter has such capacities and deny them to mind? When all allowance is made for the unscrupulous willingness of newspapers and magazines to publish any marvel of so-called scientific discovery that may give a momentary thrill of sensation to any jaded reader, there is still, I think, a large residuum of published matter to be accounted for only on the ground of densely honest ignorance. So many things have been vouched for by science; so many things that one would have thought absurd have been substantiated, why not one more, and why not *this* one more? Communication of science as subject-matter has so far outrun in education the construction of a scientific habit of mind that to some extent the natural common sense of mankind has been interfered with to its detriment.

Something of the current flippancy of belief and quasi-scepticism must also be charged to the state of science teaching. The man of even ordinary culture is aware of the rapid changes of subject-matter, and taught so that he believes subject-matter, not method, constitutes science, he remarks to himself that if this is science, then science is in constant change, and there is no certainty anywhere. If the emphasis had been put upon method of attack and mastery, from this change he would have learned the lesson of curiosity, flexibility and patient search; as it is, the result too often is a blasé satiety.

I do not mean that our schools should be expected to send forth their students equipped as judges of truth and falsity in specialized scientific matters. But that the great majority of those who leave school should have some idea of the kind of evidence required to substantiate given types of belief does not seem unreasonable. Nor is it absurd to expect that they should go forth with a lively interest in the ways in which knowledge is improved and a marked distaste for all conclusions reached in disharmony with the methods of scientific inquiry. It would be absurd, for example, to expect any large number to master the technical methods of determining distance, direction and position in the arctic regions; it would perhaps be possible to develop a state of mind with American people in general in which the supposedly keen American sense of humor would react when it is

proposed to settle the question of reaching the pole by aldermanic resolutions and straw votes in railway trains or even newspaper editorials.

If in the foregoing remarks I have touched superficially upon some aspects of science teaching rather than sounded its depths, I can not plead as my excuse failure to realize the importance of the topic. One of the only two articles that remain in my creed of life is that the future of our civilization depends upon the widening spread and deepening hold of the scientific habit of mind; and that the problem of problems in our education is therefore to discover how to mature and make effective this scientific habit. Mankind so far has been ruled by things and by words, not by thought, for till the last few moments of history, humanity has not been in possession of the conditions of secure and effective thinking. Without ignoring in the least the consolation that has come to men from their literary education, I would even go so far as to say that only the gradual replacing of a literary by a scientific education can assure to man the progressive amelioration of his lot. Unless we master things, we shall continue to be mastered by them; the magic that words cast upon things may indeed disguise our subjection or render us less dissatisfied with it, but after all science, not words, casts the only compelling spell upon things.

Scientific method is not just a method which it has been found profitable to pursue in this or that abstruse subject for purely technical reasons. It represents the only method of thinking that has proved fruitful in any subject—that is what we mean when we call it scientific. It is not a peculiar development of thinking for highly specialized ends; it *is* thinking so far as thought has become conscious of its proper ends and of the equipment indispensable for success in their pursuit.

The modern warship seems symbolic of the present position of science in life and education. The warship could not exist were it not for science: mathematics, mechanics, chemistry, electricity supply the technique of its construction and management. But the aims, the ideals in whose service this marvelous technique is displayed are survivals of a pre-scientific age, that is, of barbarism. Science has as yet had next to nothing to do with forming the social and moral ideals for the sake of which she is used. Even where science has received its most attentive recognition, it has remained a servant of ends imposed from alien traditions. If ever we are to be governed by intelligence, not by things and by words, science must have something to say about *what* we do, and not merely about *how* we may do it most easily and economically. And if this consummation is achieved, the transformation must occur through education, by bringing home to men's habitual inclination and attitude the significance of genuine knowledge and the full import of the conditions requisite for its attainment. Actively to participate in the making of knowledge is the highest prerogative of man and the only warrant of his freedom. When our schools truly become laboratories of knowledge-making, not mills fitted out with information-hoppers, there will no longer be need to discuss the place of science in education.

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THE FUTURE OF THE MEDICAL PROFESSION [1]

Mr. President and Colleagues: We are here to rejoice over the union of the Ohio and the Miami Medical Colleges, which

[1] An address on University Day, December 1, 1909, at the University of Cincinnati.

have become one school, the medical department of the University of Cincinnati. Each of these schools has an honorable history. Leaders and pioneers in the profession have made up their faculties, and men of most honorable record are to be found among their graduates. This amalgamation has been accomplished at much personal sacrifice on the part of some connected with each institution. When any institution of the rank and prestige held so many years by each of these schools loses its individuality some of the dreams of the past must come to naught. This is by no means an isolated instance of the merger of medical schools within the past few years in this country. In various sections this has already been accomplished. The number of medical schools is decreasing and this decrease is being brought about by the profession itself. Not only is the number of medical schools being diminished, but in all the better medical schools the bars to admission are being raised higher each year. This is a commercial age and this is preeminently a commercial country, and yet the medical profession is ridding itself of commercialism. It is demanding of those who desire to enter its ranks a higher degree of culture and intelligence than is demanded of any other profession in this country. The average requirement for admission to our best medical schools is at least two years ahead of that demanded for admission to other professional schools, and after admission, from one to two years more of time is demanded for graduation. Our best medical schools are demanding a more advanced preliminary education of their matriculates, and more time in the course, and yet the financial inducements to enter the profession are falling year by year. It requires not only more time but more money to enter the medical than any other profession. In our universities in which both law and medicine are taught the students in the two schools pay practically the same tuition and annual fees, while in addition to these the medical student must pay extra laboratory expenses. A young man in my own state may, after finishing his high school, enter the law department of the university and graduate after three years, or, if he chooses, he may read law in an office for fifteen months, then enter the law school and graduate after two years. If he wishes to study medicine, after completing his high school course, he must spend at least two years in the collegiate department of the university before he can enter upon his medical studies, for which four more years are required.

Every state in the union has a minimum legal requirement for the practise of medicine, and in some this requirement is high enough to exclude all save those who have had the best training. This restriction is for the benefit of the people, and not in the interests of the profession. Unfortunately, these legal enactments fail to reach many pseudo-medical practitioners who still prey upon the credulity of the public, such as the nostrum vender, the advertising charletan, the abortionist *et omne id genus.*

The medical profession is giving liberally of its energy, time and money in every branch of sanitation. It is doing its best in the restriction and prevention of disease. Many of our best men are serving on state, municipal and village boards of health, often without any pecuniary remuneration, and in practically all instances without adequate financial reward. The physician not only pays the taxes upon what property he possesses, but day and night he is rendering extra service to the poor of his community, and it must be admitted that many of the well-to-do trespass upon his generosity. The clinic established for the

treatment of the poor is crowded with the rich, often to the practical exclusion of those for whose benefit the charity was intended.

Let us see what the condition of the medical man in this country is to-day. In order to enter a good medical school, he must have a better preliminary education than is demanded for admission to any other professional school. Having gained admission, he must spend more money and take more time in order to gain his degree than any other profession demands. Then the young man with his degree finds it highly advantageous to take one or more years of hospital work for which he receives no financial remuneration. Before he can offer his services to the public he must pass a state examination which is more rigid than that demanded of any other profession. Finally, having hung out his sign, he walks to his dispensary or hospital, where he offers his dearly bought skill and experience to the deserving poor, many of whom ride to the same place in costly motor cars. He serves without recompense upon boards of health, and does his best to prevent disease upon the existence of which his bread and butter depend. He writes papers and gives lectures upon sanitation, and the more his advice is accepted and followed, the smaller is the number of his paying patients. When he is treating a case of any infectious disease the physician, in preventing the spread of the infection, is rendering a service to the public, which as a rule is unrecognized and seldom rewarded. In legislative halls he is crowded aside by the followers of pseudo-medicine. If his name gets into the daily papers favorably in connection with any case under his charge, his professional brethren scold, while the bold advertisement of the nostrum vender, the so-called specialist and the abortionist stare at him from the pages of both the secular and religious press. He lectures on the prevention and eradication of tuberculosis, telling how people should live in order to prevent this disease. He says that outdoor life, good, wholesome food and sanitary surroundings are the essentials, and he helps to make up the millions annually required on account of the postal deficiency, while the government mail carries to the remotest corners of the county the lying promises of so-called consumption cures. He attempts to show how intemperance saps the health of body and mind and fills our asylums, while the most deadly forms of alcohol are freely sold at exorbitant prices under the delusive names of stomach bitters, celery compound, peruna, etc. He shows the deteriorating effect of venereal disease. He tells that a large per cent. of his gynæcological operations results from this cause, while the "restorer of lost manhood" sprinkles the pages of the Sunday newspaper with his nauseating "ads." He pays a high duty on the imported microscope with which he watches the agglutination of typhoid bacilli in his early recognition of the disease, preparatory to recommending measures that may avert the epidemic, while the sugar trust bribes the custom inspector and the corporation accumulates its millions. He pays a double price for the knife with which he removes the cancerous breast of the poor woman, because the steel trust must declare a dividend.

Twenty years ago there were many medical schools in this country, owned and controlled by their faculties, to the members of which there came either directly or indirectly each year a fair financial return on the investment. It did not cost much to inaugurate and maintain a medical school at that time. A suitable building with one or two large lecture rooms, a gar-

ret for a dissecting room, a small chemical laboratory, a museum with specimens from the clinic and some inexpensive apparatus for demonstrating the elements of physics and chemistry were the essentials. The session was only six months, and two sessions completed the course. The lectures were repeated each year and both classes attended the same lectures. Possibly some member of the faculty had a microscope, which might be seen, protected from the dust, under a glass case. It was rumored among the students that a drop of water seen through this instrument had been found to be teeming with life. Rarely some professor was bold enough to actually use the microscope, and possibly he exhibited diatoms, uric acid crystals and sections of bone.

This is all changed. The medical building with all needed laboratories and equipment costs hundreds of thousands of dollars. Skilled men giving their entire time to the work are demanded in all the laboratory branches, and even the clinician has but little time for outside remunerative work.

I do not think that I have overdrawn the picture of the present conditions of the medical man in this country. The medical schools that were paying properties thirty years ago are now being donated to the universities. Medical education has become so expensive that it can be provided only by institutions that are endowed or receive financial support from the state or the municipality. The advance made in medical education in this country in the past ten years is greater than that of any other profession. To fit one for the practise of medicine, higher preliminary training, more time and more money are required. Notwithstanding these things, the average income of the medical practitioner in this country is decreasing year by year. He does much for the public good for which he receives neither recognition nor reward. As a member of this profession I am making these statements without the slightest bitterness and even without complaint, because I believe that the profession is preparing itself to do the greatest good for the race, that it is in training to render mankind the highest service, and that its members in the near future must be leaders in an evolution such as the world has never known. I am by no means sure that the profession in general is to be credited with being conscious of the great work that lies before it, or of preparing itself for the high station to which it is to be called. The civilized world has reached a period in its evolution in which the educated medical man must play an important part. Without his help the development of the race can not proceed as it should. Man has reached a period in his development when he has become conscious of the fact that the great work of advancing his race towards physical, intellectual and moral perfection is a duty which falls upon himself. The creature has been elevated to the dignity and power of a creator and this imposes upon him a responsibility that he may not and can not avoid.

The history of civilization is being re-written, and in the light of to-day there is being read into it a lesson that the world can not ignore. History has heretofore dealt almost exclusively with questions of politics, with literature, customs, manners, etc. The influence of disease upon the decline and fall of nations has been until recently overlooked. Professor Jones has shown quite conclusively that the plasmodium of malaria was the greatest factor in the decay of Greek civilization and did much to render the once virile Roman an easy victim to the more robust Goth and Vandal. The buried cities of Asia and

northern Africa fell into ashes under the withering curse of disease. In Spain the Moors reached a high degree of civilization. They built the wonderful city of Cordova and filled its great library with the most advanced science of the day. This people supplied the most skilful physicians of the time. Returned to Africa, their descendents degenerated into the barbarians whom to-day we know as the Riffs of Morocco.

Civilized people have come to a realization of the fact that disease constitutes the greatest bar to human progress, and that nation which first frees itself from the bondage of disease will dominate all others. In that land the superman will first be born. Two conditions are essential before any nation can free itself from disease. In the first place it must possess an educated, scientific medical profession. In the second place, the nation as a whole must be guided by the advice of its best medical men. With either of these conditions wanting no people will be able to advance.

Are we, the people of the United States, held in the bondage of disease? One out of every seven of us die of tuberculosis; fifty thousand of us perish annually of typhoid fever, and ten times this number lie stricken for weeks each year with this disease, but ultimately recover. Pneumonia disputes with tuberculosis the right to be called the captain of death. Some 50,000 of us die annually of cancer and other malignant growths, more than 25 per cent. of our children die before they reach five years of age. In short, more than 80 per cent. of us die from causes that are preventable, and which the enlightened nation of the future will prevent.

I am not sure that our nation will be able to fully comply with either of the conditions mentioned. I do know that the better medical schools in this country are doing their best to prepare the profession of the future for this work. Encouragement in regard to the second condition comes from the general interest shown in the recently developed campaign against tuberculosis, the large and small contributions in aid of this work and the ready response made by many of our state legislatures in the enactment of laws tending to restrict this and other infectious diseases; also from the generous contributions that have recently been made for the study and abatement of uncinariasis and pellagra. We, of the profession, have frequent cause for impatience with the laity for their indifference towards matters of public health, but we should remember that the attitude of the world towards the causation of disease can not be suddenly and completely changed. Disease has for countless generations been regarded as of divine or mystic origin, as an infliction from heaven, sent either in love or in anger. This old superstition still casts its shadow over us and consciously or unconsciously influences the conduct of many. It is difficult for a nation within a generation to cast off the superstitions of the fathers. This can be done, however, by instructing the children in sanitary matters. Leibnitz said: "Give me control of education for a generation and I will change the world."

What will be some of the functions of the medical man of the future? In my opinion, the most important of these may be grouped in certain classes, and it is of the greatest importance that these should be fully appreciated, especially by those interested in medical education. In the first place, that nation will be most favorably situated which does the most for the prosecution of medical research. Every scientific medical discovery so far made has been a blessing to mankind. Medicine has not been advanced by philosophical dogma; it has grown and has yielded its rich and

beneficent fruits only as a result of slow, laborious research. The chemist, bacteriologist, pathologist and clinician have obtained results, not by sitting in their studies or libraries and evolving theories from their inner consciousness, but by experimentation and close, accurate observation in their laboratories, and at the bedside. For more than a thousand years before the time of Pasteur there were occasional medical men who believed that certain diseases are spread by living contagions. In the fifth century before our era Empedocles of Agrigento taught that stagnant water breeds disease and he is said to have delivered the city of Selinunte from an epidemic of fever by draining a swamp in the vicinity. And yet, in the year 1905, twenty-four centuries later, according to Ross, out of a total population of about two and one half millions in Greece not less than one million had malaria and nearly six thousand died from this disease. About two thousand years ago Varro in his "Rerum rusticarum," in advising concerning the location of a country house, wrote as follows: "Adimadvertendum etiam si qua erunt loca palustria, et proter easdem causas, et quod crescunt animalia quædam minuta, quæ non possunt occuli consequi, et per æra intus in corpus, per os ac nares perveniunt atque difficiles efficiunt morbos," and yet the plasmodium of malaria devastated the fair fields of southern Italy and continued to hold sway, awaiting the time when a French army surgeon, Laveran, at an isolated post in the same malaria-ridden Africa, should demonstrate the cause of this disease, the giant enemy to the civilization of the Mediterranean coast. Then came the researches of Ross and others by which the part played in the distribution of malaria by the mosquito was demonstrated, and now the fertile lands of the Roman campagna promise to become the home of a busy, contented and happy people. Findlay thought that a certain mosquito might be a factor in the distribution of yellow fever, but this was demonstrated to be a fact only by the careful and heroic investigations of Reed and his colleagues. Small-pox was well-nigh universal until the careful observations and practical experiments of Jenner relieved man of the heavy tribute that he paid to this disease in death and disfigurement. Anthrax and hydrophobia levied a heavy tax on both man and beast until brought under man's control by the genius of Pasteur. Diphtheria with its death rate of from 50 to 60 per cent. alarmed the physician and awakened the horror of the community until the patient labors of Behring and Roux gave the world antitoxin. The beneficent action of anesthesia was foreshadowed by Davy and brought to full realization by the experiments of Long, Wells, Jackson and Morton. The true nature of tuberculosis was brought to light by the studies of Vilemin and Koch, and upon the knowledge thus gained it is within the power of man to stamp out this and other infectious diseases. A list of the great discoveries of scientific medicine is too long to give fully. This investigation into the causation and prevention of disease is not complete, it is barely begun. No disease that afflicts man or beast is thoroughly understood; in all cases the knowledge in the possession of the wisest medical man is but fragmentary, and in regard to the nature of many diseases we are still in complete ignorance. For instance, we know practically nothing as yet of the cause of cancer and but little of that of insanity. We are just beginning to practise vaccination against typhoid fever and other acute infections. The greatest problem that lies before the most advanced nations to-day is to free themselves from

disease, and this can be accomplished in only one way, and that is, the development and maintenance of medical research. This is a national and community problem, and that nation which does this most generously and most wisely will dominate the world, because it will become the strongest and the best. At present it must be admitted that Germany is in the lead, and the predominance of the German is due to his universities and the encouragement that he has given to scientific research. American medical research grows stronger year by year. There are numerous laboratories that are turning out most creditable work, but we need more of them and better equipment for those we have. The nation, the several states and the large cities can make no better investment than that given for the purpose of widening the knowledge necessary to keep the people in health. We may reasonably hope that the discoveries to be made in our laboratories will tend to decrease poverty, diminish sickness, prolong life, increase the effectiveness of the individual, add to the comfort and contentment of the people, and give to our country in the coming generations stronger and better men and women. A certain number of medical men of the future must give their lives to research work. However, this number will always be relatively small.

It is my intention to speak especially of the medical practitioner of the future. This individual's duties are to be quite different from those of the medical practitioner of the past, and if the world is to profit, as I hope it may, by the aid of medical science, the attitude of the profession toward the public and that of the public toward the profession must radically change. Heretofore the medical man has been taught from the beginning of his professional studies that he must not talk about professional matters to the laity. He has been made to feel that his duty is to practise and not to preach. To a certain extent this is wise and must hold for the future, as it has for the past. The practise of the profession, so far as the relations of physician and patient are concerned, is sacred and must not become matter for gossip. All understand this and no man worthy to be a member of the profession will for a moment forget or cease to hold sacred his relation to his patient. But the medical man of the future must become a public teacher, instructing his community and advising with those in authority concerning the good of the whole. In doing this he must use, in a proper manner, of course, the usual avenues of reaching the public, such as the popular magazine and the daily newspaper. Up to the present time the only instructor of the public in matters pertaining to disease has been the charlatan who has made extensive use of the daily press. This must be altered for the public good. The medical man must disseminate through this and other avenues the knowledge necessary to combat disease, and there has been nothing more encouraging in the attempt, just now begun, and of necessity led by the profession, to stamp out tuberculosis and to diminish the other infectious diseases than the readiness with which the newspapers of this country have taken up the matter. The national anti-tuberculosis society is sending twice a month material bearing on this subject to hundreds of newspapers, and they are making proper use of it. I know of no reputable newspaper that has declined to participate in this great work. The best and most accurate information concerning the prevention of disease must be diffused through the masses. The medical man of the future must talk and write on these subjects not exclusively for the benefit of

his fellows in the profession, but especially for those outside of it. Ignorance concerning these matters is appalling not only among the uneducated but among the educated as well. There are many teachers in our public schools, not only in the primary and secondary schools, but in our colleges and even in our universities as well, who are in absolute ignorance of the most elementary principles of hygiene. There are master architects planning our buildings, both public and private, who have no knowledge of ventilation. They may produce imposing elevations and design beautiful cornices and pleasing facades, but they are ignorant of the proper distribution of air and light. I predict that the time does not lie many generations in the future when many of the national, state and municipal buildings upon which the present looks with pride will be regarded as relics of a barbaric, at least a semi-barbaric, past. There are members on our public water commissions who could not distinguish between a typhoid bacillus and a yeast plant. As a rule, the men who enact our laws, both national and state, know nothing of that greatest asset that a people may have, which is health. Sometimes this amounts to a national calamity. I need only refer to the fact that when we last assembled a great army, within less than three months, and without seeing the enemy, nearly one fifth of those who enlisted were incapacitated by disease. This was due essentially to two things. First, Congress in its stupidity and ignorance had failed to make proper provision for the medical service. There was not a microscope in a camp in the United States army in 1898, so far as I know, until the necessity for its use was made evident by thousands of cases of typhoid fever, at first wrongly diagnosed as malaria—a mistake that could not have been made had the medical service been equipped as the then surgeon general wished it to be. But Congress would not listen to the man who was regarded by many of its members as only a scientific crank. In the second place, the line officer of that time, and no one appreciates his high average character more than I do, and I saw much of him, was too often deaf to his medical assistant and comrade. Shortly after the Japanese-Russian war I had occasion to compliment a high medical officer of the former nation on the low Japanese death rate from disease, when he replied: "We know nothing more about the hygiene of armies than you do. In fact, what we do know we learned from America and Europe, but our line officers accepted our advice so far as was possible."

Health is, as I have stated, a nation's best asset, and yet the sums devoted to maintaining the health of our people by the nation and by the several states are paltry in the extreme.

We need not worry about a low birth rate, but we should regard a high death rate as a national disgrace and a sign of national decay. As the race grows wiser and stronger in body and intellect these rates quite naturally approach the same level. This was made plain by Herbert Spencer more than fifty years ago. No nation that neglects the health of its people can hope to endure, and that government that secures for its citizens the longest average life in health is the best, whatever its tariff laws may be. These facts are being understood more or less thoroughly by some of the most advanced nations, and in doing this work the medical profession must lead the way. The medical educators of this country realize this much more fully than any one else can, and laying aside personal ambitions and especially pecuniary considerations, they are striving to prepare

for the next generation a profession made up of men of broad culture and of special scientific skill. This is the explanation of mergers in medical colleges, of the rapid advance in the requirements for admission to medical schools, and for the extension of the course. The medical man of the future must be a leader in all that pertains to the highest welfare of his country. His help is necessary in order to relieve the people from the bondage of disease.

Permit me to briefly point out some of the specific ways in which the medical profession can be of benefit to the people. The civilized world is awakening to the knowledge that the infectious diseases are preventable, the most enlightened of the nations are adopting measures to prevent them, and there is to be a healthy rivalry among the countries to see which can do this first and in the most effective manner. This is demonstrated by the crusade now being inaugurated against tuberculosis. We may reasonably expect improved methods in the treatment of this disease, and such knowledge as will give this to us must come as a result of the labors of scientific medical men. But the great effort must be made in its prevention, and this is, and will continue to be, a community problem, into which the nation, the state and the locality must throw their best and wisest efforts. Knowledge of the nature of the disease, its avenues of dissemination, and the means necessary for its restriction, must come into the possession of all classes and conditions, and the medical profession must be the source of this information. The practical application of this knowledge must be directed by the same body of men. The practitioner must recognize the disease in its incipient stages, before the infected individual becomes a possible center for the infection of others, and while the process in himself can be arrested. This will be demanded of every physician in the future, and the people must learn wisdom enough to go to the doctor before it is too late. Sanitoria and hospitals for the education and treatment of the infected must be provided by the public. This attempt to restrict and eradicate so grave and widespread a disease is the greatest and most beneficent undertaking that man has ever assumed, but it is not a visionary dream. It is a herculean task, but one not beyond the accomplishment of intelligence and effort.

Typhoid fever and other diseases, disseminated so frequently by contaminated water and milk, need not exist, and the heavy tribute that we pay annually to these infections is not complimentary to either our intelligence or our brotherly love, one for the other. The millions that we lose every year in deaths from these diseases would, if properly expended, soon place a safe water supply in every city and village.

It is time for us to stop attempting to control the venereal diseases by moral suasion. A false modesty has prevented us from talking about these distempers, and they should be added to the list of dangerous and communicable diseases, and every person found infected with one of them should be put in custody until he or she is free from the infection.

The time will come, if the world is to progress in intelligence, when every person will undergo a thorough examination at the hand of a skilful physician twice or oftener, each year. An official record of each such examination will be made, and no two consecutive examinations will be made by the same physician; and after death an autopsy will be made. Then the careless and unskilled physician will soon find himself without a vocation.

The world has never been in greater need of the enlightened medical man than it is

likely to be in the next generation, and the world will demand that he be worthy of the tasks that will fall upon him. No other profession will be able to render greater service to mankind. The incentive to enter the profession is not likely to be great, measured in the coin of the realm, but measured by the good done to the race, there will be none greater. The function of the new, combined medical department of the University of Cincinnati will be to prepare properly its students for worthy service in that profession which has always labored for the uplift of mankind.

A regular and frequent thorough physical examination of every citizen must be adopted by the people if the race is to be freed from disease. The good that can be accomplished by this is not limited to the infectious diseases. There are many disorders of metabolism which, if detected in time, may be arrested or cured. I will at present refer to only one of these. There are many men and women just passing the prime of life who are developing a glycosuria. At first this is in many instances a pathological condition that is easily controlled by a proper diet. Often it begins with a diminished capacity on the part of the individual to properly dispose of a few special carbohydrates. Which these are should be determined and eliminated from the daily food. In his ignorance the individual continues to eat the food which for him has become a poison. After some months or years the condition grows more grave. The person becomes incapable of properly metabolizing any carbohydrate and finally he can no longer utilize the carbohydrate group in his protein food. Having reached this point, the individual becomes cognizant of the fact that he is not well and he goes to his physician, but the condition is now incurable.

This is given simply as an illustration of the great good that an educated medical profession might render the public by constant supervision of the public health, but in order to bring this about both the profession and the public must be educated along scientific lines. It must be begun among the more intelligent, and its good results becoming apparent, it will be adopted by all. In Michigan University this work has been started. Every medical student must submit to a thorough physical examination each semester, and if any abnormality be detected, the individual must follow rules and regulations if he is to continue in the school. We hope in a few months to extend this to the students of all departments of the university. There is no better place to begin this beneficent work than in our institutions of higher learning. With us no student will be permitted to use the gymnasium until he is found by actual examination to be free from venereal disease, and any one attending the gymnasium may be called upon to submit himself to an examination at any time. Those having other physical defects will be placed under such restrictions as the medical men may impose.

The nation that will profit in the future from the labors and discoveries of the medical profession must help in this cause. It must make large appropriations for scientific research. It must render financial aid to medical education, which has become too costly for the profession itself to provide, and it must not permit of the use of short roads to practise. While the advanced medical educator in this country is doing his best to elevate his profession, pseudomedicine is filling the lobbies of every state capitol with demands for legal recognition, and too often it happens that our law makers are not wise enough to distinguish between the true and the false. This imposes a heavy duty upon the profession, and

that is the one which I have already emphasized—the education of the public. To one who has had occasion to interview our legislators, both national and state, in behalf of public health affairs, the situation often becomes most depressing. The task seems hopeless and one is inclined to forego all effort. Men high in the councils of the nation say without hesitation that this talk about stamping out tuberculosis is only a doctor's fad. As one listens to such talk, as I have, from high sources, his national pride hides its face in shame and he wonders to what destination his country is drifting with such colossal ignorance guiding its course. But, as medical educators our duty is clear, and it has fallen to us to prepare the next generation of those who will be able to render a far greater service to human progress than the world has yet seen. With the race freed from disease, both inherited and acquired, the better man will be born and will dominate the earth. I am not enough of a prophet to predict anything concerning the nationality of the superman who is to come and possess the earth, but he will not come to a disease-ridden people, for the intellectuality and morality of a nation depend upon its physical health, and the historian of the future will have no difficulty in convincing his readers that we who lived in the early part of the twentieth century were not so wise as we believed ourselves to be, as he points out our high mortality rate from preventable diseases, and shows what feeble efforts were made to prevent them.

VICTOR C. VAUGHAN

THE NUMBER OF STUDENTS IN GERMAN UNIVERSITIES

SOME statistics regarding the number of students in the twenty-one German universities, which have lately appeared in the *Frankfurter Zeitung*, may be of interest to the readers of SCIENCE.

The number of students matriculated in the summer semester of 1909 reached the total of 51,510, as compared with 48,717 in the winter of 1908–09, and 47,799 in the preceding summer.

In thirty years the increase has been as follows:

Year	No. of Students	Per 100,000 Population
1879	19,771	43.7
1889	29,491	——
1899	33,563	——
1909	51,510	78.4

The relative increase in the principal subdivisions may be shown in the following table:

	Number		Per 100,000 Population	
	1879	1909	1879	1909
Philological and historical studies	2,724	7,690	10.6	20.6
Mathematics and natural science	1,563	3,503	6.1	9.4
Law	3,179	7,259	12.3	19.5
Medicine	2,061	4,879	8.0	13.1
Theology (evangelical)	1,036	1,211	5.9	5.6
Theology (catholic)	330	1,014	3.5	8.4
Pharmacy	301	896	1.2	2.4

It will be noted that the percentage increase in medicine has about kept pace with the increase in law, while the proportion of students in mathematics and natural science has not increased so rapidly as that in philological and historical studies. The number of students of evangelical theology shows a relative falling off (although a slight absolute increase), but catholic theology records a greater relative increase than any other subject.

Some interesting facts are also given respecting the extent and nature of inter-university migration. In the summer months of 1909, 28.6 per cent. of the Prussian students were registered in the German universities outside of Prussia, for the most part (18.7 per cent.) in the South German universities of Bavaria, Baden (Heidelberg and Freiburg) and Württemberg (Tübingen). On the other hand, only 5.8 per cent. of the Bavarian, 8.4 per cent. of the Baden and 10.7 per cent. of

the Württemberg students were matriculated in Prussian universities. In Heidelberg there were 763 Prussians and 654 Badenese, and in Freiburg 1,437 Prussians and 688 Badenese, a state of affairs probably due in large part to the attractive surroundings of the two Baden universities.

Edwin O. Jordan

LECTURES IN SANITARY SCIENCE AT COLUMBIA UNIVERSITY

The committee in charge announces the following lectures in the course in sanitary science and public health for the second term, 1909-1910:

February 1—A. H. Seymour, Esq.: "The Development of Public Health Law and the State Control of Health."

February 3—A. H. Seymour, Esq.: "Provisions of Public Health Law as applied to Specific Regulation."

February 8—Dr. V. E. Sorapure: "Transmission and Prevention of some Infectious Diseases."

February 10—Dr. V. E. Sorapure: "Immunity."

February 15—Dr. James Ewing: "Cancer and its Relation to Public Health."

February 17—Dr. W. Gilman Thompson: "The Occupation Diseases of Modern Life."

February 22—Professor A. D. MacGillivray: "Insects and the Transmission of Disease."

February 24—Professor A. D. MacGillivray: "Insects and the Transmission of Disease."

March 1—Dr. John B. Huber: "Tuberculosis, its Nature and Causes."

March 3—Dr. John B. Huber: "Tuberculosis, its Prevention and Cure."

March 8—Hon. Homer Folks: "Voluntary Organization in Public Health Work."

March 10—Dr. John H. Pryor: "Results of Tuberculosis in New York State."

March 15—Dr. E. R. Baldwin: "Early Diagnosis of Tuberculosis."

March 17—Dr. D. M. Totman: "Local Quarantine Measures."

March 22—Dr. H. H. Crum: "The Supervision of Infectious Diseases."

March 24—Dr. H. W. Wiley: "Food Adulteration and its Effects."

March 29—Professor E. M. Chamot: "The Detection of Food Adulteration."

March 31—Professor E. M. Chamot: "The Detection of Food Adulteration."

April 5—Professor W. A. Stocking: "Dangers of Impure Milk."

April 7—Professor W. A. Stocking: "Dairy Hygiene."

April 12—Dr. L. H. Gulick: "School Hygiene."

April 14—Professor G. W. Cavanaugh: "Animal Wastes and their Disposal."

April 19—Professor H. N. Ogden: "The Relation of the Engineer to Sanitation."

April 21—Mr. Geo. C. Whipple: "Principles of Water Purification."

April 26—Mr. Theodore Horton: "Water Purification Plants."

April 28—Professor H. N. Ogden: "The Problem of Sewerage."

May 3—Mr. H. B. Cleveland: "Sewage Disposal Plants."

May 5—Professor Alfred Hayes: "The Law of Nuisances."

May 12—Rudolph Hering: "The Garbage Problem."

May 17—Professor C. A. Martin: "House Planning with reference to Health."

May 19—Professor C. A. Martin: "The Healthful House."

May 26—Professor G. N. Lauman: "Health in Rural Communities. Public Health."

SCIENTIFIC PUBLICATIONS FOR FREE DISTRIBUTION

On January 13 a resolution was passed in the House of Representatives ordering the whole stock of the scientific publications named below in the House Folding Room to be disposed of in order to make room for new documents. Any reader of Science desiring to procure any of these documents should apply to the member of congress from the congressional district in which he resides *within sixty days* from the date of passage of this resolution.

The publications to be distributed free are as follows:

Geological Resources, Cripple Creek, Colo.

Geological Report on Mercur Mining District, Utah.

Astronomical Papers of the American Ephemeris, Vols. 5 and 6.

Catalogue, Prehistoric Works.

Indian Languages: Algonquin, Athapascan, Chinookan, Iroquoian, Muskhoegan, Salishan.

National Academy of Sciences.—*Memoirs:* Vols.

2, 3, 3 pt. 2, 5, 6, 8, 9. *Reports:* 1883, 1887 to 1889, 1891, 1895, 1906 to 1908.

Ohio Earthworks.

Geological Survey.—*Water Supply and Irrigation Papers:* Nos. 148, 153 to 232, 234, 235. *Bulletins:* Nos. 269, 275, 277 to 301, 303 to 379, 382 to 389, 392 to 395, 399 to 403. *Professional Papers:* Nos. 44 to 67. *Annual Reports:* 2d to 28th, 1880–81 to 1907.

Washington Astronomical Observations: 1881 to 1890.

Entomology: 1880–1885 (2 vols.).

Rocky Mountain Locusts (2 vols.).

Coast Survey Reports: 1872, 1886 to 1897–8, 1906.

Fish Commission Reports: Parts 3 to 29, 1877 to 1903.

Fish and Fisheries: 1904, 1905.

Nautical Almanac: 1885 to 1909.

SCIENTIFIC NOTES AND NEWS

A DEPARTMENT of experimental biology has been organized in the Rockefeller Institute. Professor Jacques Loeb, of the University of California, has been elected head of the department. He will begin his work at the Rockefeller Institute next autumn.

MR. GIFFORD PINCHOT has been elected president of the National Conservation Association. Dr. Charles W. Eliot, the first president of the association, has been elected honorary president.

A NATIONAL testimonial with a purse of $10,000 for Commander Robert E. Peary is planned for the evening of February 8, at the Metropolitan Opera House, New York City. Governor Hughes will preside. Commander Peary will tell the story of his trip to the pole and show new pictures of the far north.

AT a recent meeting of the board of trustees of Cornell University, in New York City, it was resolved on the motion of President Schurman that the secretary send the following telegram to Director Bailey: "The Trustees of Cornell University, assembled at the winter meeting, send cordial New Year's greeting to Director Bailey, and rejoice with him in the prospect of still greater work for the agricultural interests of the state, under his leadership, in the College of Agriculture of Cornell University."

AT a dinner given on January 18 in honor of Professor William James, professor emeritus of philosophy at Harvard University, a portrait of Professor James was presented to the university by the members of the division and by the visiting committee. The painting, which is by Miss Ellen Emmet, of New York, is of three-quarter length and life size. For the present it will hang in Emerson Hall, but eventually it will be placed in the faculty room of University Hall.

THE permanent portrait committee of the medical department of the University of Pennsylvania has, during the past few years, almost completed the collection of portraits of former professors in the Medical School. These portraits now hang in the halls and lecture rooms of the new medical laboratories and thus connect historically the new home of the medical department with memories and traditions of teachers of the past century and a half. Of the six professors not at present represented in this collection, one is Dr. Simon Flexner, who was professor of pathology for the years 1899 to 1903 and responsible, wholly or in part, for the instruction in pathology received by the classes of 1900 to 1905. A special committee consisting of representatives of these classes and of Dr. Flexner's associates and assistants during the years of his incumbency, has been appointed by the permanent portrait committee to take such action as may be necessary to procure Dr. Flexner's portrait.

ON his sixtieth birthday, January 14, Professor W. O. Crosby was presented with a silver loving cup by a number of present and past instructors in the department of geology of the Massachusetts Institute of Technology.

DR. RICHARD DEDEKIND, professor of mathematics in the Brunswick School of Technology, has been given an honorary doctorate of mathematics by the Zurich Polytechnicum.

OFFICERS of the Entomological Society of America have been elected as follows: *President,* Dr. John B. Smith; *First Vice-presi-*

dent, Dr. S. A. Forbes; *Second Vice-president,* Professor V. L. Kellogg; *Secretary-Treasurer,* C. R. Crosby; *Additional Members Executive Committee,* Professor J. H. Comstock, Dr. W. M. Wheeler, Mr. E. A. Schwarz, Professor L. Bruner, Rev. Professor C. J. S. Bethune, Professor J. M. Aldrich.

THE annual meeting of the council of the American Physical Education Association was held at the Rittenhouse Hotel, Philadelphia, on Saturday, January 1, 1910. The following officers were elected: *President,* Dr. George L. Meylan, Columbia University; *Secretary-editor-treasurer,* Dr. J. H. McCurdy, International Y. M. C. A. Training School, Springfield, Mass. The next convention of the association will be held in Indianapolis, March 1–3, in connection with the Department of Superintendents of the National Educational Association and the American School Hygiene Association.

DR. O. TETTENS, of Frankfort, has been appointed observer in the Aeronautical Observatory at Lindenberg, near Berlin.

DR. KARL GROOS, professor of philosophy and pedagogy at Giessen, has resigned his chair at the university.

DR. ALEXANDER G. RUTHVEN, of the University of Michigan, will conduct a zoological expedition to southern Mexico, during the coming summer.

DR. FREDERICK BEDELL, of the department of physics, at Cornell University, will spend the remainder of the year abroad on sabbatic leave.

DR. ALVIN S. WHEELER, associate professor of organic chemistry in the University of North Carolina, has been granted a year's leave of absence to study abroad. He will leave with his family for Germany on May 24.

DR. J. C. ARTHUR, of Purdue University, Indiana, is spending the month of January consulting the cryptogamic and phanerogamic collections of Harvard University, while Mr. Frank D. Kern, of the same institution, is engaged in similar work at the New York Botanical Garden. It is expected that another installment of the rusts of North America will soon be made ready for publication. As the rusts are strictly parasitic, the work requires an almost equal familiarity with the systematic position of fungi and the flowering hosts.

AT a stated meeting of the American Philosophical Society, on Friday evening, January 21, Dr. Ernest Fox Nichols, president of Dartmouth College, and late professor of experimental physics in Columbia University, read a paper entitled "Some Recent Investigations in Physics."

A JOINT meeting of the American Ethnological Society and the Section of Anthropology and Psychology of the New York Academy of Sciences was held at the American Museum of Natural History on Monday, January 24, when a public lecture was given by Professor Franz Boas, of Columbia University, on "The Changes in the Physical Characteristics of the Immigrants to the United States."

DR. L. A. BAUER addressed the students of physics and engineering at Northwestern University on January 12 and at the University of Cincinnati on January 14, his subject being "The Non-magnetic Yacht *Carnegie* and her Work."

ON January 14 Professor C. J. Keyser, of Columbia University, delivered a lecture at Princeton University on "Ways to Pass the Walls of the World; or, Scientific Speculations regarding the Figure and the Dimensions of Space."

AT McGill University the following are acting as special lecturers during the present session:

Professor J. F. Kemp, of Columbia University, on "The Application of Geology to certain Engineering Problems."

J. B. Tyrrell, Esq., F.G.S., on "The Geological Relations of Alluvial Gold Deposits, as Illustrated more Particularly by those of the Yukon District."

D. B. Dowling, Esq., of the Geological Survey of Canada, on "The Geology of Coal, with especial reference to the Coal Deposits of the Province of Alberta."

F. W. Cowie, Esq., C.E., chief engineer of the

Montreal Harbor Commission, on "The Construction and Development of Harbors."

WILLIAM GEORGE TIGHT, professor of geology and natural history at Denison University from 1887 to 1901 and since then until a few months ago president and professor of geology at the University of New Mexico, fellow of the Geological Society of America and of the American Association for the Advancement of Science, died at Glendale, Cal., on January 15, at the age of forty-five years.

Mr. William Abner Eddy, known for his work in aerial photography, has died at Bayonne, N. J., in his sixtieth year.

COLONEL GEORGE EARL CHURCH, born in Massachusetts in 1835, but latterly residing in England, known for his geographical work in various parts of the world, died on January 4.

DR. FRIEDRICH KOHLRAUSCH, author of the "Lehrbuch der praktischen Physik" and former president of the Physikalisch-Technische Reichsanstalt, died suddenly at his home at Marburg, Germany, on January 18.

DR. MORITZ GRESHOFF, director of the Colonial Museum at Haarlem, known for his work on physiological botany, has died at the age of forty-seven years.

THE late Darius Ogden Mills, of New York City, has bequeathed $100,000 to the American Museum of Natural History; $50,000 to the New York Botanical Garden and $25,000 to the American Geographical Society of New York City.

THE first Hookworm Conference was held in Atlanta, Ga., on January 18 and 19. The conference opened with about 500 in attendance and a representation from twelve states. Dr. Henry F. Harris, secretary of the Georgia State Board of Health, was elected temporary chairman and Mr. William Whitford, of Chicago, secretary. The principal speaker was Dr. Charles Wardell Stiles, U. S. Public Health and Marine-Hospital Service, Washington, D. C. A permanent organization was effected under the name "Southern Health Conference."

THE Boston *Transcript* reports that four interconnected projects for fisheries exhibits at South Boston are proposed. These are an aquarium, a fish culture station, a museum of the appliances, methods and industrial statistics of the fisheries, and a trade school for fishermen.

THE department of vertebrate paleontology of the American Museum of Natural History has received as a gift from Mr. Charles Lanier, one of the trustees, a skull of the Cretaceous dinosaur Triceratops. This specimen was collected in the Laramie Cretaceous of Seven-Mile Creek, Western County, Wyoming, about forty-five miles northwest of Edgemont, South Dakota, by Mr. Charles H. Sternberg.

THE Naples Table Association for Promoting Laboratory Research by Women announces that applications for the table supported by the association should be made before March 1. The fourth prize of $1,000 for a thesis containing laboratory research in biological, chemical or physical science will be awarded in April, 1911. Further information may be obtained from Mrs. A. D. Mead, 283 Wayland Avenue, Providence, R. I.

MR. ROOSEVELT has written from Nairobi, under the date of December 15, 1909, the following letter to the secretary of the Smithsonian Institution:

I have to report that the Smithsonian Expedition under my charge has now finished its work in British East Africa and is about to leave for Uganda. The collections made in British East Africa include:

Mammals, large, in salt	550
Mammals, small, in salt	3,379
Birds	2,784
Reptiles and batrachians, about	1,500
Freshwater and marine fish, about	250
Total vertebrates	8,463

In addition the collections include a large number of mollusks and other invertebrates; several thousand plants; in the neighborhood of two thousand photos; anthropological materials, etc.

Up to January 17 only a little over a quarter of the collections enumerated in Mr. Roosevelt's letter had reached the institution. In addition to the mammals mentioned by him, there have, however, already been received perhaps 150 skulls of large mammals which are

not associated with skins, these being picked up in the field for the study of the variations in individual specimens. Word has recently been received of the killing by Mr. Roosevelt of two specimens of the white rhinoceros, an adult female and calf. These will be of particular value to the museum which has no representative of this species in its collection.

Consul-General Richard Guenther, of Frankfort, writes that the Kosmos Association of Naturalists in Stuttgart, the Duerer League and the Austrian Imperial Association for Ornithology in Vienna have united in an address to the public calling for subscriptions to create a Natural Protective Park. This address was published last spring and since then has been followed up by a convention in Munich well attended by naturalists and scientific men from all parts of Germany. An organization was effected, called the Verein Naturschutzpark, with headquarters in Stuttgart. The plan is to create three large parks, one in the Alpine Mountain Range, one in the highlands of central Germany and the third in the low country of the north. The main object is to preserve and increase certain species of animal and plant life. The parks are expected to become centers of attraction and recreation for millions of people, natives and foreign visitors. The fee for membership to this park association will be quite low, to encourage hundreds of thousands to join.

UNIVERSITY AND EDUCATIONAL NEWS

The trustees of Columbia University propose to remove the College of Physicians and Surgeons from its present location on West Fifty-ninth street to a commanding site on Morningside Heights, adjacent to the other schools of the university. A large part of the necessary land has been obtained by the gift of Messrs. William K. Vanderbilt, George J. Gould, Frank A. Munsey and a fourth anonymous contributor.

Mr. J. S. Huyler, of New York, has given $20,000 to Syracuse University.

The Commonwealth Edison Company of Chicago and the General Electric Company of Schenectady have jointly presented to the department of electrical engineering of the University of Illinois a 125-kilowatt steam turbo-generator. The turbine of this unit is to be non-condensing. The generator is to be designed for 3-phase, 60-cycle currents, to be delivered at 2,300 volts. With the addition of this machine the electrical laboratory will be prepared to deal extensively with problems involving single-phase, quarter-phase and three-phase currents.

A museum of Industrial Chemistry has been established at the University of Illinois under the division of applied chemistry.

The trustees of Cornell University have voted to meet the congestion in the department of chemistry by an extension of North Morse Hall westward a distance of about 40 feet, and the building committee was instructed to have the enlarged building ready for occupancy in September.

The statement to the effect that Mrs. Phoebe A. Hearst has decided to erect for the University of California a museum of anthropology is incorrect. Mrs. Hearst explicitly denied the report the day after it appeared in the paper which first published the story.

An anonymous donor has given to the University of Paris an annual income of 30,000 francs to found ten fellowships at foreign universities.

We learn from the *Journal* of the American Medical Association that the council of the University of Paris and the Pasteur Institute have agreed to construct, at the joint expense of the two institutions, a laboratory for the study of the phenomena of radioactivity and their therapeutic applications. The projected laboratory will comprise two parts: one for scientific researches under the direction of Mme. Curie, the other for medical applications under the direction of the Pasteur Institute. The latter will contribute towards the expenses of construction and equipment of the institution 400,000 francs, from the Osiris legacy.

Dr. William Huntington, president of Boston University, proposes to retire at the end of the present academic year.

DR. EDMUND CLARK SANFORD will be installed as president of Clark College on February 1.

A. H. SUTHERLAND, Ph.D. (Chicago), of the Government Hospital for the Insane at Washington, has been appointed instructor in psychology in the University of Illinois.

DR. ISSAI SCHUR has been promoted to an associate professorship of mathematics in the University of Berlin.

DR. KNOLLER has been appointed associate professor of aeronautics in the Vienna School of Technology.

DR. DIETZIUS has qualified as docent for aeronautics in the Berlin School of Technology.

DISCUSSION AND CORRESPONDENCE

FALL OF A METEORITE IN NORWOOD, MASSACHUSETTS

DURING the night between October 7 and 8, 1909, a meteoric stone fell to earth on the farm of Mr. W. P. Nickerson, of Norwood, Mass. The meteorite is a ham-shaped mass of very hard gray stony material, much corrugated on the surface, about two and one half feet long in its greatest dimension. one foot to nearly one and one half feet broad, and varying from one foot to one half foot in the third dimension. I estimated its volume as about 1.75 cubic feet, its weight as perhaps 275 pounds, and its density as not much over 2.5. The material has a flow structure, like that of an ancient lava which has solidified during flow, but is completely crystalline. It is, therefore, entirely different from any meteorite on record. The stone is about as hard as petrosilex, and has a slight salty odor. Laminæ from 2 to 4 millimeters thick, perhaps on an average 5 to 10 mm. apart, disposed in a parallel order, project from the surface to the extent of several millimeters, resembling in this respect a much weathered piece of laminated felsite, except that there has been no chemical alteration of the superficial layer such as occurs in felsitic weathering. The laminæ are distinctly parallel, their general direction transverse to the longer axis of the mass. The projections, although rounded, exhibit a remnant of crystalline form. They are in fact phenocrysts of plagioclase feldspar. Several small cavities, a few millimeters in diameter, are recognizable, but the greater part of the surface is without any pitting, other than that of the normal, and everywhere present, structural corrugation.

The bolide fell vertically through the bars of a gateway, breaking every bar and burying itself in the sand directly underneath to a depth of three feet. It was this fresh break which attracted the attention of one of the farmer's men in the early morning of Friday, October 8. The top of the stone was about six inches below the level of the surface in the interior of a cavity in the ground not much over a foot wide. The top of the stone was still appreciably warm the following morning at 7 A.M., according to Mr. Nickerson, and the bottom was decidedly warm ("hot" is the word used by the man who first felt it). A neighbor, Miss Stuart, of Westwood, in whose candor and honesty I have complete confidence, arrived at the spot just after the stone had been exhumed, handled its surface without gloves, and declares that it was so hot that she did not care to keep her hands on it very long. One of Mr. Nickerson's hired men independently told me the same. The moisture in the surrounding earth had been converted into steam which, in blowing off during its escape, had brushed off, and thus cleansed the *lower* surface of the meteorite—the surface of impact—which was cleaner than the upper surface, a fact which attracted the attention and surprise of the diggers who could not account for it. The sand had been so thoroughly dried that it sifted back into the hole as the stone was pried out, although the surrounding soil of the pasture was damp. The bolide passed through the bars so swiftly that the rather weak side supports were not injured. One hard wood bar was cut with a sharp fracture. Some smaller and weaker ones were more or less torn.

It seems to me probable that when a bolide succeeds in penetrating to the denser layers of the atmosphere at a very low angle, the up-

ward elastic reaction of the air becomes so great that the meteorite rebounds, but if the angle of the path is a high one, atmospheric friction and impact retard the meteoric velocity to so great an extent that gravity gets the victory, and the last part of the meteor's fall is vertical. If this conclusion is correct, there should be some evidence that bolides which strike the ground fall more often than not in a vertical direction. I am not aware that such evidence has been sought, or especially noted. The present instance is so well authenticated, that it seems worth putting on record. Subsequent investigation has proved that the fall of the meteorite occurred at about quarter before seven o'clock on the evening of Thursday, October 7, as witnessed by several people in Norwood.

FRANK W. VERY

WESTWOOD, MASS.,
October 12, 1909

A LABORATORY ILLUSTRATION OF BALL LIGHTNING

IN Dr. Elihu Thomson's address at the opening of the Palmer Physical Laboratory at Princeton University he made, with regard to ball lightning, the statement, "The difficulty here is that it is too accidental and rare for consistent study, and we have not as yet any laboratory phenomena which resemble it closely."[1] This suggested to me that a phenomenon which I witnessed some six or seven years ago might be worth recording.

With a copper wire a student accidentally short-circuited the terminals of an ordinary 110-volt circuit. I happened at the time to be a few meters from him and to be looking toward the terminals. At the instant of the short circuit I saw an incandescent ball which appeared to roll rather slowly from the terminals across the laboratory table and then disappeared. As I remember it, I should say that the ball may have appeared to be about three centimeters in diameter. I think no one else in the room saw anything more than a flash of light—much as if a fuse had blown. On the table where the ball had rolled we found a line of scorched spots, as if the ball had bounced along the table and had scorched the wood wherever it touched. As I remember them, these scorched spots were rather close together, perhaps not more than one or two centimeters apart. In the top of the table was a crack perhaps a millimeter or two wide, and at this crack the scorched line ended. In a drawer immediately under this crack we found a tiny copper ball, perhaps a millimeter in diameter. Apparently the ball that rolled along the table was incandescent copper vapor, although my memory of it is rather of a yellow-white than of a greenish light.

The above suggested the possibility of a laboratory study of a phenomenon which may very possibly be similar to that of ball lightning, but I have never attempted to repeat the experiment.

A. T. JONES

PURDUE UNIVERSITY

[1] SCIENCE, XXX., p. 868, December 17, 1909.

BALL LIGHTNING

TO THE EDITOR OF SCIENCE: In the address on "Atmospheric Electricity" by Professor Elihu Thomson, on pages 867 to 868 in the issue of December 17, reference is made to lightning in the form of a ball of fire. This calls to my mind an experience which I had some fifteen years ago while watching a heavy electrical storm. I observed what appeared to be a ball of fire between two and three feet in diameter rolling along the street. It was also accompanied by several others of smaller size. This appearance occurred just after a very heavy electrical discharge to a telephone pole some few squares away. The discharge along the telephone wire heated the wire to red heat. The wire broke on account of this heating and a section of some considerable length was hurled along the street with a whirling motion. The rapidity of the rolling motion gave the appearance of a ball, as it also gave a forward motion to the ball of fire. Subsequent investigation revealed the two ends of the wire dangling from adjacent poles with a considerable length of the wire missing. I beg to suggest that the rapid heating of metal particles in some manner similar to this may be the cause of many of the so-called balls of lightning.

LOUIS M. POTTS

BALTIMORE, MD.,
January 10, 1910

THE CIVILIZATION OF BOHEMIA

WITH reference to Dr. Hrdlička's article in SCIENCE of December 17, p. 880, it may be of interest to note the prominence of Bohemia in zoological research. In gathering material for the "Directory of Zoologists," I have obtained biographical data from fourteen prominent zoologists resident in Prag, namely, Babák, Počta, v. Lendenfeld, Stölc, Klapálek, Perner, Rádl, Babor, Frič, Vejdovsky, Němec, Srdinko, Steinach, Völker. Any zoologist looking at this list will recognize familiar names. Prag in 1900 had a population of 204,498. There are many cities in America which could not make nearly so good a showing; for example, New Orleans, with a population of 287,104; or Los Angeles and Denver combined, with a population between them of 236,338.

T. D. A. COCKERELL

ENGINEERING STUDENT STATISTICS

TO THE EDITOR OF SCIENCE: President Howe, of the Case School of Applied Science, has called my attention to an error which in some strange way crept into the table of engineering student statistics that was published in the issue of SCIENCE for June 4, 1909. In the table the number of students is given as 479 in 1907–8 and 431 in 1908–9. The catalogues show that the number of students for 1907–8 was 440 and for 1908–9 445, thus showing a slight gain instead of a loss of 10 per cent.

A reference to the reports of the president of Cornell University proves that the statement made by me in the issue of December 24, 1909, to the effect that at Cornell the number of undergraduate women in the academic department is probably larger than that of the men is not borne out by the facts of the case. On page 18 of the president's report for 1908–9 the following statement appears: "This increase in attendance in the College of Arts and Sciences has taken place in spite of a slight decline in the number of women enrolling in that college. In 1907–8 there were 313 women and 507 men, in 1908–9 there were 309 women and 593 men." No distinction is made between men and women in the figures furnished for the table included in the number of SCIENCE to which reference has been made.

RUDOLF TOMBO, JR.

THE STRICT APPLICATION OF THE LAW OF PRIORITY TO GENERIC NAMES

MR. FRANK SPRINGER, on the first of May last, distributed to one thousand zoologists and paleontologists a circular bearing upon the question of the rigid application of the so-called "law of priority" in zoological (and paleontological) nomenclature. The generic name *Encrinus,* the best known and supposedly the most firmly established of all of the generic names of the Crinoidea—the name of the typical crinoid genus of all authors, both of learned systematic works and of general treatises and text-books, for over one hundred years—was shown to be untenable as previously understood, having been earlier employed (a use long since forgotten) for other and widely different genera, this application of necessity, if section 30 of the international code were rigidly followed, causing the preoccupation of other generic names equally well established. The case was still further complicated by the intricate technical problems in regard to the earlier usage of the name *Encrinus,* and the great zoological difficulties in the way of a positive identification of the earlier genotypes, altogether causing such confusion that the most expert taxonomists differ widely in their interpretation of the facts.

The circulars were distributed by the undersigned, except those destined for Norway, Sweden, Denmark and Germany; Dr. Th. Mortensen very kindly undertook the task of sending them to the naturalists in these countries, and for his courtesy in thus assisting us we take this opportunity of offering him our most sincere thanks.

A post card was enclosed with each circular, the recipient being requested to return it with the information whether, in his judgment, it would be better to retain the name *Encrinus in statu quo ante* (with the genotype *E. liliiformis* Lamarck) or to follow strictly the dictates of the code and overturn the heretofore universally accepted nomenclature of a large

and important group, a group which, above all others, is of prime importance to a very large number who can not, from the nature of their work, occupy themselves with laborious taxonomic research in a more or less alien field.

The reception accorded the circular was extremely gratifying, graphically demonstrating the deep interest taken in nomenclatorial questions not only by systematists, but by zoologists and paleontologists interested in all the varied phases of their subjects; to those who have so kindly acceded to our request and have acquainted us with their personal views we beg to tender our most cordial thanks.

Replies have been received from zoologists and paleontologists resident in the following countries: Algeria, Austria-Hungary, Brazil, Canada, Ceylon, Denmark, Egypt, England, Finland, France, Germany, Hawaii, Holland, Ireland, Italy, Jamaica, Japan, New South Wales, New Zealand, Norway, Philippine Islands, Portugal, Queensland, Russia, Scotland, South Australia, Sweden, Trinidad, United States, Western Australia and Victoria.

Of these working zoologists and paleontologists 80 per cent. are entirely dissatisfied with the present course of procedure; and this number is by no means inclusive merely of those having only an indirect interest in systematic work, but is made up to a surprising extent of the most prominent systematists; 83 per cent. are more or less dissatisfied with the methods now in vogue; about 18 per cent. believe it best to adhere to the code in its present form, and 15 per cent are convinced that this is the only logical and reasonable course.

The individual replies will, of course, be considered in the light of confidential communications, and therefore no indication will be given as to how any one has answered; when the canvass is concluded a minute analysis of it will be published, together with the names of those who have replied, showing the existing sentiment in the greatest detail for each class of workers, and for workers in the various groups, and a synopsis will be given of all the suggestions which have been sent in, with the proportionate numerical strength of each, each suggestion being duly and specifically accredited to its author or authors, who will have the opportunity of finally revising it before it is sent to press. It is our hope that this canvass now under way will result in the formulation of an amendment to, or a revision of, article 30, by which zoological nomenclature may attain a true stability and henceforth be freed from the constant and perplexing changes now abounding on every side.

We beg that all zoologists and paleontologists who read this notice and who have not yet sent in their decision will do so at once; and that they will favor us with an expression of their views in regard to the best means of attaining a more stable system of zoological and paleontological nomenclature than we have at present.

Owing to press of other duties, Mr. Springer will not be able to continue further the work which he has started; he has therefore requested me to take it up and carry it on to its conclusion, analyzing and preparing for publication the final results. In order that these may be as expressive as possible of the true sentiment of working zoologists and paleontologists as a whole, he joins with me in urging all interested in the subject of nomenclature, no matter in what branch of zoology or paleontology their interest may lie, to submit their opinions, whether for or against the present method of procedure, and to assist us in the formulation of a possible means of escape from the nomenclatorial difficulties which on every side beset the path of the modern naturalist.

Austin H. Clark
1726 Eighteenth St.,
Washington, D. C.

SCIENTIFIC BOOKS

A College Text-book of Geology. By T. C. Chamberlin and R. D. Salisbury. 8vo, xvii + 978 pp., illustrated. New York, Henry Holt and Company. 1909.

This book seems to be a concentrated form of the three-volume work on geology by the same authors and published by the same company, 1904–1906. Such a boiling down of one's results is usually a tedious process, and

the results are not always satisfactory either to authors or readers. In the present case, the results must be regarded as remarkably satisfactory, when looked at from the point of view of the common run of students. It is to be expected that the book will not satisfy the demands of everybody, but teachers of geology will agree that brevity has its advantages as well as its disadvantages. For example, the condensed statement of the three principal theories regarding the origin of the earth is the best we have seen, though it does not, of course, do away with the necessity of studying their fuller discussion elsewhere. The book is not, however, a simple condensation of the larger work, for the results have been gleaned and added from many papers published since the larger work came out.

In our opinion the authors have done well to lump dynamical and structural geology together and to treat it as a whole.

The chief faults that can be found with the work are matters of editing, and consequently are of no great importance.

The several maps showing the land and water areas at different periods have the rather annoying defect of lacking explanations of the conventional shadings. References are made, to be sure, to preceding cases, but inasmuch as such a book is seldom read consecutively, one finds it pretty tiresome to have to back up, as it were, from page 830 clear to page 445 to be sure that he is interpreting the conventionals properly.

Many of the effective illustrations of physiographic forms used in the larger works are given in this volume also. It seems unfortunate that some of the political boundaries that belong in the originals from which these extracts are taken have been left to mar these excellent illustrations. For example, in Plate XI., opposite page 172, are fragments of two such lines that are entirely meaningless in the plate. In Plate IX., opposite page 156, the international boundary might advantageously be omitted entirely, as it is already omitted in part. In Plate VIII., opposite page 133, the line down the middle of the stream in Fig. 1 might well be cut out. Opposite page 96, Plate I., Fig. 1, is another such line that is over conspicuous and meaningless as the illustration stands. Of course these lines in some instances serve some purpose, in others they do not. The work of cutting them out of the engraving is very little, even if they are not "stopped out" in making the plates.

At page 288 the shading of Fig. 186 to represent the land seems to have been overlooked. At page 240, Fig. 196, a photograph of the Fiescher glacier, is labeled "Aletsch glacier."

The larger work by these authors must long remain as a landmark in North American geology and the work of reference for all serious students and for all teachers and workers. But the "College Text-book" meets the larger demand of a larger number of readers both in our institutions of learning and outside of them.

The appearance of this new and important book again calls attention to the shortcomings of some of our best American publishers. When are we to have in this country a book on geology as well manufactured as Geikie's text-book? We have the geologists competent to prepare the text, but our publishers seem to be afraid that the cost of a really well-made book will shut it out of the market. We can not believe it. It is true that we have more text-books on geology than we need, but not more by such men as Chamberlin and Salisbury than we need.

J. C. BRANNER

STANFORD UNIVERSITY, CAL.,
December 10, 1909

A Revision of the Entelodontidæ. By O. A. PETERSON. Mem. Carn. Museum, Vol. IV., No. 3, 1909, pp. 41–146, with Pls. LIV.–LXII. and 80 text figures.

In this important memoir Mr. Peterson discusses at length the remarkable group of swine-like forms generally known as the Elotheres. In his introductory remarks, however, the author replaces the more familiar family name Elotheridæ Pomel by that of Entelodontidæ Amyard on the ground of inadequate description, no illustrations and loss of type by Pomel, though the name he proposed may have appeared first.

A careful revision of the family, genera and species follows in which are described as valid the genera *Entelodon* with two species; *Archæotherium* with four species and one subspecies —including those usually grouped under the genus *Elotherium;* the subgenus *Pelonax* including three species; *Dæodon,* two species; *Dinohyus,* one species, and *Ammodon,* one species. The forms known as *Elotherium imperator* and *Elotherium superbum* can not be generically determined.

A history of the discovery and working of the famous Agate Spring Quarry follows together with geologic notes and a diagram of the Miocene section.

In discussing the cause of the deposit at Agate Spring which has rendered up so abundant and wonderfully preserved a fauna, Mr. Peterson imagines the location to have been the favorite crossing place of a stream which at times contained engulfing quicksands. The remains are those of animals which attempted to cross at the unfavorable intervals.

A detailed description of that marvelous Suilline, *Dinohyus hollandi,* is next given—a brute of rhinocerine bulk. Two restorations are given of the skeleton, one of which is an actual photograph of the mounted specimen followed by that of a model showing the possible appearance of the animal in the flesh.

In conclusion Peterson tells us that the Entelodontidæ constituted a collateral branch of the Suidæ which diverged in early Eocene time. They are nearest the pig and hippopotamus among recent forms.

In geographical distribution they are found especially in Europe and North America, none as yet having been reported from Asia. They were comparatively abundant on the flanks of the Rocky Mountains and existed also in California and New Jersey. From the Lower Oligocene upward and before the close of the Miocene they occupied certain areas from the Pacific to the Atlantic coasts of North America.

Mr. Peterson's work shows painstaking care and thought and advances our knowledge of this interesting group very materially. It is especially valuable in the clearing up of synonymies and in defining the various valid types.

Richard S. Lull

Yale University

The Cranial Anatomy of the Mail-cheeked Fishes. Edward Phelps Allis, Jr., in Zoologica (herausg. von Professor Dr. Carl Chun), H. 57, B. 22. Stuttgart. E. Schweizerbartsche Verlagsb. 1909. Quarto, 219 pages, 8 plates.

This is another example of the painstaking descriptive work for which zoology is so greatly indebted to Mr. Allis. The work is illustrated by splendid lithographic plates after drawings by the artist Nomura from special preparations. The greater part of the paper is devoted to the descriptive anatomy of the skeleton of the head, and its chief value lies in the attention to detail in the text and the accuracy with which the figures are executed. The morphology of the myodome and the criteria of segmental relations in the cranial nerves are discussed at some length. The myodome is believed to be the homologue of the cavernous and intercavernous sinuses of the human skull.

With regard to the segmental relations of cranial nerves, Allis states that "there is a marked tendency to consider the central origin of a given cranial nerve of much more importance for the determination of its segmental position than the course of the nerve and its general relations to the skeletal elements." This he attributes to the acceptance of the neurone theory, according to which nerve fibers follow always the path of least resistance to their destination. According to this conception the points of origin of nerve components in the central nervous system give the only positive criteria as to their segmental position, and their peripheral course is explained by accident, individual experience or elective selection. The author thinks this view unfortunate and not well founded.

The reviewer has never observed the tendency of which Mr. Allis speaks. On the contrary, the segmental position of a nerve is determined primarily on the basis of its periph-

eral course and distribution. The conclusions derived from these facts may be modified by the embryonic or the phylogenetic history, which may give evidence that the nerve has reached its observed adult position through secondary shifting or change of course. The point of view is illustrated in the recognition of the ophthalmicus profundus as a separate segmental nerve in spite of its central origin in common with the trigeminus in every vertebrate. Also, in the shifting of the roots of several cranial nerves from segment to segment. Also, in the analysis of the vagus into several segmental nerves because of its peripheral relations. Also, in the recognition of a general cutaneous component in each segmental nerve, including the facialis, although all these components are commingled in a non-segmental central nucleus. The statement made by Allis expresses a profound but not uncommon misconception of the attitude and method of students of nerve components. Without exception these workers would agree with Allis in attaching primary importance to the peripheral course and distribution of nerves, but they would not agree that this is in any way inconsistent with the neurone theory.

What has led Allis to the statement quoted above is the fact that communis fibers have not been recognized as a primary component of the trigeminus as a segmental nerve. He argues in substance as follows: in some fishes communis fibers are distributed by way of the rami of the trigeminus and, generally, cutaneous fibers run in the hyoideo-mandibular ramus of the facialis. In *Amia* and *Petromyzon* cutaneous fibers are present in the root of the facialis. Why should not both communis and cutaneous components be assigned to both trigeminus and facialis? Students of nerve components have assigned the communis fibers to the facialis and the cutaneous fibers to the trigeminus, except where they run in the *root* of the facialis, on phylogenetic grounds. In forms not provided with an operculum the cutaneous component in the hyoid segment is primitive and has its root and its ganglion cells in the facialis root and ganglion. In operculated forms (with the single exception of *Amia* so far as known) this cutaneous component in the facialis has disappeared and fibers from the trigeminus have secondarily invaded facialis territory to supply the operculum.

Similarly, in primitive forms no communis fibers have been found in the trigeminus. In fishes in which taste organs are present in the outer skin of the head, such fibers are distributed by way of the trigeminal rami, but they leave the brain in the facialis root and have their ganglion cells in the facialis ganglion. Their distribution is therefore secondary and they belong to the facialis segment. The same is true of the facialis root fibers which go to the fins, or even the tail, to supply taste buds.

It is one advantage of the neurone theory that such cases as this are explained without difficulty, while upon the Hensen hypothesis of primary continuity of nerve cell and end organ, it is inconceivable how taste organs in the skin should have secured a nerve supply at all, since the taste organs in primitive forms were wholly entodermal and the cutaneous nerves did not carry any fibers to innervate them.

J. B. JOHNSTON

SCIENTIFIC JOURNALS AND ARTICLES

The Journal of Biological Chemistry, Vol. VII., No. 2, issued January 8, 1910, contains the following: "Effects of the Presence of Carbohydrates upon the Artificial Digestion of Casein," by N. E. Goldthwaite. The digestion of casein is retarded by the presence of carbohydrates. "The Quantitative Separation of Calcium and Magnesium in the Presence of Phosphates and Small Amounts of Iron Devised Especially for the Analysis of Foods, Urine and Feces," by Francis H. McCrudden. Description of a new method. "A Note on the Estimation of Total Sulphur in Urine," by Stanley R. Benedict. Criticism of Ritson's method. "The Fate of Sodium Benzoate in the Human Organism," by H. D. Dakin. Daily doses of 5 to 10 grams of sodium benzoate for two or three days are eliminated practically quantitatively in the urine as hippuric acid.

An improved method for estimating hippuric acid is described. "A Chemical and Bacteriological Study of Fresh Eggs," by M. E. Pennington. A series of comprehensive chemical analyses of whites and yolks of fresh eggs with the separation and study of the bacteria within them. Thirty-six species were isolated and identified. "Phlorhizin Glycocholia," by R. T. Woodyatt. Under the influence of phlorhizin, dextrose appears in the bile. "The Toxicity of Thallium Salts," by Robert E. Swain and W. G. Bateman. A study of the symptoms which are caused by thallium salts.

THE contents of *Terrestrial Magnetism and Atmospheric Electricity* for December, are as follows: "Exhibit of the Magnetic Work of the Carnegie Institution of Washington, December 13–18, 1909" (Frontispiece); "Some of the Problems of Ocean Magnetic Work," by L. A. Bauer; "Magnetic Storm of September 25, 1909, as Recorded at the Cheltenham Magnetic Observatory," by J. E. Burbank; "Letters to Editor"; "Biographical Sketch of Adolf Erman, 1806–1877"; "Portrait of Adolf Erman"; "Time and Direction at the Poles of the Earth," by W. J. Peters; "Notes"; "Abstracts and Reviews."

SUMMARIES OF SIX OPINIONS (9, 11, 13, 15, 17, 18) BY THE INTERNATIONAL COMMISSION ON ZOOLOGICAL NOMENCLATURE

THE following summaries of recent opinions by the International Commission on Zoological Nomenclature are published for the information of persons interested in the points in question. It is expected that the full details of the arguments will be published later in connection with certain other cases now under consideration. These summaries do not give the reservations made by certain commissioners, but these reservations will be presented in the final publication.

9. *The Use of the Name of a Composite Genus for a Component Part requiring a Name.*—The decision as to whether the name of a composite genus, when made up wholly of older genera, is tenable for a component part requiring a name, depends upon a variety of circumstances. There are circumstances under which such name may be used, others under which it may not be used. (Art. 32.)

Vote: Affirmative, 12; negative, 0; not voting, 3.

11. *The Designation of Genotypes by Latreille, 1810.*—The "Table des genres avec l'indication de l'espèce qui leur sert de type," in Latreille's (1810) "Considérations générales," should be accepted as designation of types of the genera in question. (Art. 32.)

Affirmative, 11; negative, 1; not voting, 3.

13. *The Specific Name of the Sand Crab.*—Catesby's (1743) prelinnæan name *arenarius* is not available under the code, although "reprinted" in 1771; *quadratus* 1793 is stated to be preoccupied; *albicans* 1802, being the next specific name in the list, becomes valid, under the premises submitted.

Affirmative, 10; negative, 0; not voting, 5.

15. *Craspedacusta sowerbii* Lankester, 1880, n. g., n. sp., vs. *Limnocodium victoria* Allman, 1880, n. g., n. sp.—*Craspedacusta sowerbii* Lankester, 1880, June 17, has clear priority over *Limnocodium victoria* Allman, 1880, June 24. Presentation of a paper before a scientific society does not constitute publication in the sense of the code. The commission is without authority to sanction usage in contravention to the provisions of the code.

Affirmative, 15; negative, 0.

17. *Shall the Genera of Weber, 1795, be Accepted?*—Weber's "Nomenclator entomologicus," 1795, complies with the requirements of Article 25, hence the genera in question are to be accepted, in so far as they individually comply with the conditions of the code.

Affirmative, 11; negative, 1; not voting, 3.

18. *The Type of Hydrus Schneider, 1799, 233.*—On the basis of the premises submitted by Dr. Stejneger, *Hydrus caspius* Schneider, syn. *Coluber hydrus* Pallas, is the type of Schneider's genus *Hydrus*, according to Article 30 (d). The fact that Schneider refers to the page and number of this species establishes the point in question and the fact that the name *Coluber hydrus* was not quoted is

perhaps unfortunate but not essential to decide the question at issue.

Affirmative, 13; negative, 0; not voting, 2.

C. W. STILES,
Secretary of Commission

THE MEXICAN COTTON BOLL WEEVIL

PROBABLY the control of no insect pest has involved greater difficulties than that of the cotton boll weevil. This enemy of a great staple crop works in such a manner that it has seemed beyond the usual means that have been followed in insect control. In all except the adult stage it is found within the fruit of the cotton plant. For the greater portion of its existence, therefore, it is at least as well protected as it would be if it occurred some distance below the surface of the soil. Even in the adult stage the insect has habits that tend to place it beyond the reach of man. As a consequence, investigations of the insect that have been carried on for several years have not revealed a great number of direct remedial measures. In fact, the destruction by burning of the left-over portion of the crop and the insects contained is the only direct means of importance that has been devised. It is gratifying to note that recent investigations by Mr. Wilmon Newell and Mr. G. D. Smith, of the Louisiana State Crop Pest Commission, published in Circular 33 of that commission, reveal another direct means of control that gives promise of general applicability. The work of Messrs. Newell and Smith is of considerable general interest, because it shows a successful outcome from continued investigation leading from a suggestion revealed in research. The investigators observed a clue pointing toward the possibility of control and directed all their energies toward the practical perfection of the idea.

For some years a cotton planter of considerable prominence has been advocating vigorously the use of paris green for the control of the boll weevil. Though well-meant, his campaign has been based upon a demonstrated fallacy. Extensive tests that have been made by various agencies have shown that the application of this poison is by no means a practical means of destroying the boll weevil. One of the agencies that tested the use of paris green was the Louisiana State Crop Pest Commission, of which Mr. Newell is the executive head. Although large and repeated applications did not result in increasing the yield of cotton in the experimental fields, it was evident, both in these tests and in cage experiments, that a number of weevils were killed. Instead of stopping at this point, Mr. Newell conceived the idea of determining wherein the paris green was ineffective and how its action might be increased. There were two important difficulties to overcome. In the first place, as paris green is now manufactured, a small portion of free arsenic causes burning of the foliage of plants. As the amount of the poison applied is increased, this damage, though insidious and at first scarcely noticed, becomes greater until it is very serious. On this account increasing the amount of paris green in the first experiments offered no hope as a practical remedy. The second obstacle encountered was the difficulty of forcing the poison into the portions of the plants where a considerable number of weevils would be likely to obtain it. The mechanical structure of the poisons in use prevented this. They were too coarse for effective work. To obviate the first difficulty, Mr. Newell determined to use arsenate of lead, which can be applied in very large amounts without any injury whatever to the foliage. The second difficulty was overcome by inducing a manufacturer to put up a special, finely powdered form of the poison. When this point was reached, a considerable series of field experiments was outlined. These experiments comprised about forty-six acres of cotton to which the poison was applied, as well as forty-nine acres provided as control areas. The treated cotton in these experiments produced an average of 71 per cent. more than similar cotton in the checks. In some cases the net profit was even startling. In one case a net profit of over $23 per acre was obtained.

A large portion of the effectiveness of the application of powdered arsenate of lead in the experiments was undoubtedly due to the thoroughness with which the work was done.

A special device, involving an air blast, was used to force the poison into the parts of the plant most frequented by the adult weevils. In the experiments described the application was made in person by the junior author, Mr. Smith, or under his personal supervision. It is possible, and in fact is forcefully pointed out in the report, that such successful results as those obtained in some of the experimental work should not be expected under the practical conditions on plantations. The writers even point out that it is likely that nine out of ten planters will fail to obtain satisfactory results from the first work they do. Nevertheless, every consideration seems to indicate clearly that powdered arsenate of lead can be used very profitably as an important adjunct in connection with the system of control that has been in use heretofore.

It is not extreme to state that the work accomplished with powdered arsenate of lead by Messrs. Newell and Smith marks an important advance in our knowledge of the control of the boll weevil. It promises in a short time more than to compensate the state of Louisiana for all the money that has been expended in the operations of the Crop Pest Commission since its establishment.

W. D. Hunter

U. S. Department of Agriculture

SPECIAL ARTICLES

DOUBLE IMAGES OF AN OBJECT AS SEEN THROUGH A WATER SURFACE

In Science of November 29, 1901, the present writer discussed this subject as presented by Matthiessen.[1] It was there pointed out that Matthiessen's equations had all been deduced in a paper by the present writer, in 1881, in the *Transactions of the Academy of Science of St. Louis*.

Matthiessen urged that two images of an object are formed when it is viewed through a water surface. One lies upon the caustic of refraction, and is therefore above the level of the object, and nearer to the eye. The other is along the same line of sight, but on the normal through the object.

In my paper of 1881 the latter image was discussed as the one actually seen.

It is evident that all rays from a point on an object thus viewed, will when produced backwards, not only be tangent to the caustic but will also cut the normal. Every ray of the cone of rays whose base is the pupil of the eye will thus appear to pass through an area on the surface generated by revolving the caustic around the normal. They will also intersect between two limiting points on the normal. The image of the point will therefore appear as distorted into an area on the caustic surface, and as a short line on the normal. My idea has always been that the former image was too indistinct to be visible.

Recently, while deducing the equation of the caustic, it occurred to me that the image might be seen upon the caustic surface, if the head were inclined so that the eyes were in the same vertical plane. The axes of the two cones of rays make then with each other an angle lying in the vertical plane, and the eyes may be focused on their point of intersection. The images on the caustic will then be practically superposed, and the line images on the normal will be more widely displaced on each other. The experimental result is very striking, and may easily be obtained by observing a chain, or the water-plug and chain at one end of a bath tub filled with water.

When both eyes are used, the water plug with the vertical chain, to which it is attached, appears projected towards the observer by a foot or more, if the eyes are near the surface and at the opposite end of the bath tub. If one eye be now closed, the image recedes to the vertical line through the object, appearing along the same line of sight as before. It therefore appears at a lower level.

When both eyes are in the same horizontal plane, the image is seen on the normal through the object. The images on the caustic surface as seen by the two eyes are then displaced on each other, and those on the normal coincide. Opening and closing one eye then produces no change in the position of the image.

Francis E. Nipher

[1] *Ann. der Physik*, 1901, No. 10, S. 347.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

SECTION A—MATHEMATICS AND ASTRONOMY

As the American Mathematical Society held its annual meeting in affiliation with the American Association the special program of Section A did not include any technical mathematical papers. The most striking features of the program of this section were the joint sessions with Section B and the American Mathematical Society. The fact that such eminent men took part in these sessions enhanced the interest and called more general attention to the need of closer relations between scientific bodies representing neighboring subjects. In particular, the need of frequent conference between the physicists and the mathematicians can not be too strongly emphasized in the present stage of our development, and it is to be hoped that the eminently successful joint session of Sections A and B will tend to spread and intensify the appreciation of this need.

The address of the retiring vice-president, Professor C. J. Keyser, of Columbia University, was given during the joint session of Section A and the American Mathematical Society, held on Wednesday morning, December 29. During the same session Professor D. E. Smith, of Teachers College, Columbia University, read his paper on the work of the "International Commission on the Teaching of Mathematics." Professor Smith is chairman of the United States section of this important commission, the other members appointed by the central body are, Professor W. F. Osgood, of Harvard University, and Professor J. W. A. Young, of Chicago University. The paper by Professor C. Runge, Kaiser Wilhelm exchange professor of mathematics at Columbia University for the present academic year, was read at the joint session of Sections A and B and the American Mathematical Society, held on Tuesday afternoon. At the same session Professor E. W. Brown read his first paper.

An interesting feature of the program was the visit to Harvard College Observatory on Monday afternoon at the close of a brief session of the section. The director of the observatory, Professor E. C. Pickering, invited Sections A and E to visit the observatory at this time and he explained to them photographs and illustrations of work in progress. In view of the fact that Percival Lowell failed to reach Boston before the close of the program of Section A his paper was transferred to Section B. All the papers of the following list, with the exception of the five mentioned above, were read at the three special sessions of Section A. These special sessions were held on Monday afternoon, Tuesday morning and Wednesday afternoon. The complete list of papers accepted for the program of Section A is as follows:

1. "The Thesis of Modern Logistic" (vice-presidential address), by C. J. Keyser.
2. "On the Determination of Latitude and Longitude in a Balloon," by C. Runge.
3. "On Certain Physical Hypotheses sufficient to explain an Anomaly in the Moon's Motion," by E. W. Brown.
4. "The Work of the International Commission on the Teaching of Mathematics," by D. E. Smith.
5. "The Value of the Solar Constant of Radiation," by C. G. Abbot.
6. "A New Mode of Measuring the Intensities of Spectral Lines," by F. W. Very.
7. "The Absorption of Light by the Ether of Space," by F. W. Very.
8. "The Fireball of October 7, 1909," by F. W. Very.
9. "On a Recent Hypothesis and the Motion of the Perihelion of Mercury," by E. W. Brown.
10. "The Heliocentric Position of Certain Coronal Streams," by J. A. Miller and W. R. Marriott.
11. "The Mutual Relation of Magnifying Power, Illumination, Aperture and Definition in Telescopic Work," by David P. Todd.
12. "La Contribution Non-euclidienne à la Philosophie," by G. B. Halsted.
13. "Declination of the Moon for Greenwich Mean Time," by D. H. E. Wetherill.
14. "Meteorological Waves of Short Period and Allied Solar Phenomena," by H. W. Clough.
15. "Recent Work with the 6-inch Transit Circle of the United States Naval Observatory," by Milton Updegraff.
16. "The Canali Novæ of Mars," by Percival Lowell.
17. "Peculiar Star Spectra indicating Selective Absorption of Light in Space," by V. M. Slipher.
18. "Personality with the Transit Micrometer," by R. M. Stewart.
19. "Water Vapor on Mars," by Frank W. Very.
20. "The Existence of Anomalous Fluctuations in the Latitude as shown by Simultaneous Observations with the Zenith Telescope and the

Reflex Zenith Tube of the Flower Observatory," by C. L. Doolittle.

21. "Visual Observations of Variable Stars at the Harvard College Observatory," by Leon Campbell.

Professor Keyser's vice-presidential address appeared in full in the December 31 number of SCIENCE. In the absence of their respective authors the paper by Professor Todd and those of Messrs. Wetherill and Slipher were read by title, while that of Mr. Stewart was presented by Dr. O. J. Klotz, Ottawa, Canada. The abstracts which follow bear the same numbers as the corresponding titles in the preceding list.

2. The problem of finding your geographical position in a balloon from observations of the sun is very different from the same problem on board ship, for this reason, that in a balloon there is no dead reckoning. The method used on board ship of observing two altitudes of the sun at two different hours of the day can not be applied, for the two Sumner lines have to be shifted so as to correspond to the same moment and this can only be done by dead reckoning. In a balloon, therefore, the only way of getting your geographical position from the sun is by observing both altitude and azimuth at the same time. Now the accuracy with which the azimuth of the sun may be observed is rather small; it would be difficult to obtain it within less than one tenth of a degree. Therefore the reduction of the observations need not be very accurate, either. At the same time it is essential that the reduction should be made very quickly. For the time since the moment the observations were taken introduces an uncertainty that may be expressed by the area of a circle whose radius is equal to the distance through which the balloon may have traveled. One naturally would therefore turn to graphical methods for the reduction of the observations. The reduction consists in finding the latitude ϕ and the hour angle t from the declination δ, the azimuth a and the altitude h. Professor Runge proposes to find first the latitude ϕ from δ, a, h and then the hour angle t, from δ, a, ϕ. In both cases we have to deal with the representation of an equation between four variables. Both of these equations may be written in the following form:

$$f(p) + h(r, s) g(q) = k(r, s)$$

where p, q, r, s denote the four variables. That is to say, two of the variables enter the equations in functions of their own $f(p)$, $g(q)$ and the equation is linear in these functions, the coefficients being any functions of the other two variables. Equations of this kind may be represented graphically by the "méthode des points alignés" of Maurice d'Ocagne[1] taking $f(p)$ and $g(q)$ as line coordinates. I propose making $f(p)$ equal to the ordinate of the point of intersection of the straight line with the axis of ordinates and $g(q)$ equal to the gradient of the straight line, that is, the tangent of its angle with the axis of abscissa. In that way the rectangular coordinates of the point whose equation in line coordinates is the given equation, become:

$$x = h(r, s) \quad \text{and} \quad y = k(r, s).$$

For any given value of p, the different values of q correspond to straight lines that form a pencil of rays, whose center is on the axis of ordinates at the particular value defined by p, and any alteration of p would simply shift the center along the axis without altering the pencil of rays in any other way. The whole diagram may therefore be obtained by drawing two figures, one containing the curves $r = \text{const}$ and $s = \text{const}$, the other containing the pencil of rays, and placing these two figures in the proper way, one over the other. It so happens in our cases that the variable p is the declination of the sun, which during the ascent of a balloon may be regarded as constant. The aeronaut would therefore merely use a definite superposition of the figures. They are photographed on transparent plates and a blue print is taken by copying the plates one after another on the same paper in the proper position. The aeronaut has one blue print to read off the latitude and a second one to read off the hour angle after he has found the latitude. The equations are:

$$(1) \quad \sin\delta + \cos\phi \cos h \cos a = \sin\phi \sin h,$$
$$(2) \quad \tan\delta + \sec\phi \sin t \cot a = \tan\phi \cos t.$$

In the first equation the curves $\phi = \text{const}$ and $h = \text{const}$ are the ellipses

$$x = \cos\phi \cos h, \qquad y = \sin\phi \sin h.$$

In the second equation the curves $\phi = \text{const}$ and $t = \text{const}$ are the confocal ellipses and hyperbolas

$$x = \sec\phi \sin t, \qquad y = \tan\phi \cos t.$$

3. Newcomb has shown that there is a difference between the observed and the theoretical positions of the moon which can be roughly represented by a term of period about 270 years and coefficient 13″. In this paper Professor Brown

[1] Maurice d'Ocagne, "Traité de Nomagraphie."

examined numerous hypotheses sufficient to explain the term, in order to clear the ground of those which seemed to be of doubtful value and to bring forward those which appeared sufficiently reasonable to merit tests from observations of a different nature. Some account of three of these hypotheses was presented to the meeting. It was stated that a minute libration of the moon would be sufficient, provided it took place in the moon's equator and had the proper period. The supposition of magnetic attraction practically demanded (*a*) a periodic change in the magnetic movement of the earth or of the moon. If (*a*) were rejected, it was necessary to suppose that the mean place of the lunar magnetic axis was near the lunar equator and that the oscillations of its position took place in the plane of the equator. The observed secular change of the earth's magnetic axis could not produce the phenomenon without demanding a larger motion of the lunar perigee than observation warrants. On the border line between two sets of hypotheses was a curious fact, namely, that if the period of the solar rotation coincided very nearly with one of the principal lunar periods a minute equatorial ellipticity of the sun's mass was sufficient to explain the term. So far as known, these hypotheses do not conflict with any observed phenomena but they cause some theoretical difficulties.

4. The International Commission on the Teaching of Mathematics was suggested some years ago, but the first steps in its organization were not taken until April, 1908. At that time the Fourth International Congress of Mathematicians, then in session in Rome, empowered Professor Klein, of Göttingen, Sir George Greenhill, of London, and Professor Fehr, of Geneva, to appoint such a commission, and to arrange for it to report at the next congress, to be held at Cambridge in 1912. As a result, three commissioners have been selected from each of the leading countries and the work has actively begun. It is expected that each of these countries will submit a very full report of the nature of the work in mathematics, from the kindergarten through the college, with some discussion of the range of advanced work in the universities. In the United States the investigation is carried on by means of fifteen committees, each divided into subcommittees. About two hundred and seventy-five people are engaged in the work and the subcommittee reports will be submitted during the present winter. The committee reports will be submitted before the summer of 1910, and the national report by Easter, 1911.

5. Since 1902 the staff of the Smithsonian Astrophysical Observatory has been engaged in bolometric measurements of solar radiation to determine the "solar constant," and to note possible variations of solar emission. The measurements have been conducted at Washington (sea level), at Mt. Wilson (one mile) and at Mt. Whitney (nearly three miles). When corrected for atmospheric losses by employing Bougner's transmission formula, and reduced to mean solar distance, the average results outside the atmosphere agree within 2 per cent. On good days at Mt. Wilson or Mt. Whitney the results have a probable error of about .5 per cent. By the construction and trial of three copies of a standard pyrheliometer of new design, in which the solar heating is continuously removed by water flowing about the walls of the hollow receiving chamber, and in which the accuracy of the measurements is checked by introducing known amounts of heat electrically in test experiments, the solar constant may now be expressed absolutely in calories per square centimeter per minute. Definitive reductions are not yet quite complete, but the final solar constant value will not differ 2 per cent. from 1.97 calories per square centimeter per minute. Variations of the solar emission of several per cent. from the mean value appear not to be uncommon, but during the continuance of the Mt. Wilson observations, prolonged periods of differences of 10 per cent. from the mean value, such as were suspected in 1903, have not been observed.

6. The method described by Professor Very consists in matching the two halves of a bright line, seen projected upon a uniformly illuminated background. One half of the line (it may be either the upper or the lower half at will) is a bright line or band in a photographic negative of a spectrum crossed by dark absorption lines, or in a positive of a bright-line spectrum. The other half of the line may be, if desired, a line in another spectrum, selected for its general similarity; but the best object for comparison is a slit over an illuminated ground-glass screen with means for the following adjustments: (1) The slit can be varied in width by a micrometer-screw. (2) The illumination of the ground glass can be varied by an optical device employing an iris-diaphragm. (3) The half of the field in which the image of the slit lies can be made to duplicate the other half by altering the illumination of the slit-jaws.

7. Professor Very believes that attempts to deduce a law of extinction of light in space, based

on the relative paucity of stars of the higher orders of magnitude, are probably illusory. The rate of extinction is small, and is marked by peculiarities of stellar distribution of a larger order. The evidence of a selective absorption or scattering of light, deduced by Kapteyn, appears to be real, but it is of local origin, and some new criterion is desirable.

An examination of the distribution, size and appearance of the nebulæ shows results which are in harmony with the supposition of an absorption of light by the ether of space. An attempt is made to deduce the distances of some of these objects; and the bearing on the problem of light-extinction furnished by such facts as can be learned from the nebulæ is discussed, together with the related questions of the knowable dimensions of the universe, and its coordination into a whole by means of a conservation of energy through ethereal and material interchange. The conclusion is reached that there is an absorption of radiation by the ether of space, and that a considerable fraction of the energy of the universe resides in the interstellar medium.

8. At $6^h\,42^m$ in the evening citizens of Norwood, Mass., witnessed the fall of a brilliant orange-red fire ball which descended in a nearly vertical direction from an altitude of about 60° to the horizon, giving off laterally numerous white sparklets. The visible evidence of any explosions was lacking, and no sounds whatever accompanied the fall, which, according to the best observation, lasted about seven seconds. From internal evidence, it appears probable that the upper part of the path was seen almost end-on, and that the bolide may have reached the ground at no great distance. The claim that such was the case, and the asserted finding of a large and unique aerolite, were considered by Professor Very. Microscopic analysis shows that the stone is peculiar, and in spite of some doubtful points in the evidence, it is deemed best to put this evidence on record.

9. Professor Brown's second communication consists of a brief account of the hypotheses of Seeliger brought forward to account for the outstanding large residual in the motion of the perihelion of Mercury and the small residuals in the secular motions of the four minor planets. An analysis of the nature of the three hypotheses and a comparison of the number of arbitrary constants introduced with the number of residuals to be accounted for were also given.

10. Assuming that the theoretical corona is caused by light emitted by and reflected from streams of matter ejected from the sun by forces which in general act along lines normal to the sun's surface; that these streams are formed of a series of particles ejected from the same point of the sun's surface in such a way as to make a continuous stream, Professor Miller showed[2] that the curvature of these streams was due to mechanical causes, and that under certain conditions one could find the heliocentric position of these streams.

During the summer of 1909, Professor Miller examined and measured, at the suggestion of Director Campbell, the series of large-scale photographs of the solar corona made by him and other members of the staff of Lick Observatory, with a view of applying this theory to them. In all, there are sixteen streamers of this particular type recorded on these plates. Professors Miller and Marriott have since reduced the measures made during the summer. All the streamers measured have been reduced; there are two of them that can not be reduced according to this hypothesis. The others gave consistent and reasonable results. The purpose of the investigation was to locate, heliocentrically, these streamers. An interesting and striking by-product is, that under these hypotheses it is proved that these streamers can not assume the shape shown on the photographs unless they are acted upon, in addition to the attractive force of the sun, by a repulsive force of some kind, the magnitude of which can be determined.

11. Professor Todd's paper relates to experiments with the eighteen-inch Clark refractor at Amherst. They show the great improvement in definition of sun and moon, and the brighter planets and stars by simple reduction of the aperture to suit atmospheric conditions. Higher magnifying powers are thereby possible when the seeing is inferior, providing the illumination of the object allows. Variation of aperture from three to eighteen inches is effected by an iris diaphragm outside the objective.

12. This memoir gives the original meaning and the growth of meaning of non-Euclidean geometry, sketches its history and its founders, and points out that philosophy has found in non-Euclidean geometry a new criterion fusing into components of a new life the preexistent forms of Plato, forms of sensitivity of Kant, products of sensation of Locke, contributions of experience of Comte. Efficient science now finds trivial the old hypothesis of the importance of individual suffering, and the

[2] *Astrophysical Journal*, Vol. XXVII., No. 4.

new evasion that pain does not hurt—finds them as unnecessary as the parallel postulate.

13. For purposes of navigation, in checking the longitude, Mr. Wetherill proposes that the moon be observed in meridian altitude, and with the known latitude, the declination be interpolated in the "Nautical Almanac" for G. T. Where the change of declination is rapid per minute of time a good check can be made without the complication to the seaman of the calculation of the lunar distance.

14. Mr. Clough's study of meteorological and solar variations of short period discloses cyclical variations in the length of the period similar to those shown in 1904 to be characteristic of the 11-year and 36-year periods. The $3\frac{1}{4}$-year variation in the frequency of prominence and other solar phenomena, and the barometric pressure over Iceland and the Azores, ranges in length from about $2\frac{1}{2}$ years in 1875 to $3\frac{3}{4}$ to 4 years in 1860 and 1893, showing a 36-year variation in the length of the period. The mean latitude of the entire spotted area is farthest north about eight months previous to the occurrence of a maximum phase of the pressure wave over Iceland. A 3-month period is shown to exist in spot and prominence frequency and also in the Iceland pressures, with variations in the length of the period conforming to variations in solar activity in the $3\frac{1}{4}$-year cycle, *i. e.*, the greater the activity the shorter the period. Two shorter periods of about 33 days and 10 days have been detected in meteorological phenomena, both of which undergo variations in length through a 3-month cycle.

The $3\frac{1}{4}$-year wave of pressure recedes from the Iceland Low to the Azores High in fourteen months, while the 3-month wave traverses the same distance in forty days. The 10-day wave, however, moves eastward around the globe, a continuous series of these waves having been traced over the United States during the past three years. This fact has an important bearing on recent measurements of the intensity of solar radiation at Washington and Mt. Wilson, the atmospheric transmissibility being apparently greater at the minimum phase of the 10-day temperature wave than at the opposite phase.

15. Professor Updegraff gave an account of the progress made during the past year in fundamental observations of the sun and fixed stars with the six-inch transit circle of the U. S. Naval Observatory in conformity with the plan for fundamental work adopted by the observatory council and approved by the superintendent.

The repairs made necessary by deterioration and the alterations of the instrument having been completed, the instrument was mounted in January, 1909, and observations of stars were commenced on January 31.

The form of the pivots and the stability of the rotation axis of the instrument have been thoroughly investigated and have been found to be highly satisfactory. The instrumental constants are remarkably stable and are determined with a satisfactory degree of accuracy, the probable error of a determination of the azimuth from the marks being $\pm 0^s.006$, of the level from the spirit level $\pm 0^s.006$ and of the collimation from the collimators, $\pm 0^s.006$.

The transit micrometer has been brought into use, and after practise the accidental errors of the observers are no larger than is the case with the chronograph key, which confirms the results reported by other observers using that form of instrument elsewhere in this country and in Europe.

The flexures of the telescope tube and the circles have been partially investigated and have been found to be small, the circles having no appreciable flexure. A preliminary investigation of the division errors of circle A has been completed and the results are being used in reducing observations in declination.

A series of observations by Mr. Hammond of stars direct and reflected has been reduced and a small difference reflected minus direct has been found which gives on discussion a value of the horizontal flexure the same as that obtained from observations on the collimators.

Satisfactory rates are given by the clocks in the clock vault. The clocks are not, however, in perfect order, as the bell jars leak somewhat, but all difficulties seem to have been overcome in regulating the temperature of the vault, which is kept constant within a few hundredths of a degree Centigrade for months at a time.

More than 3,500 observations of stars have been made in conformity with the plan for fundamental work mentioned above. The main features of this plan for fundamental work are as follows:

The clock rate is determined fundamentally by observation of the same clock stars by the same observer at consecutive transits.

The azimuth of the marks is determined by observations of circumpolar stars at consecutive transits U. C. and L. C.

The latitude for the reduction of observations

in declination is determined by observations of circumpolar stars at consecutive transits U. C. and L. C.

The sun and brighter stars are to be observed daily in both right ascension and declination, and the refraction by day and by night at all zenith distances is to be separately investigated and determined.

Systematic observations are being made in both right ascension and declination of lists about an hour long in right ascension of circumpolar stars, culminating between five and seven o'clock P.M. apparent local time, and of the same lists between the same hours in the morning at consecutive culminations as far as possible. These observations are made for fundamental places of the stars themselves and for the determination of the latitude and azimuth of the instrument and marks and of the atmospheric refraction. The advantages of observations of this kind are explained in SCIENCE, Vol. XXV., p. 689.

A group of nine fundamental stars near the vernal equinox has been selected for use as the fundamental standards in right ascension. They are being observed in connection with another group of stars near the autumnal equinox and are to be connected with stars at all right ascensions with a view to detect and determine systematic errors in right ascension. This requires the observation of stars more than twelve hours apart in right ascension on the same day by the same observer, and the work is combined with the observations of circumpolar stars described above.

16. On September 30, 1909, certain new canals were observed on Mars at the Lowell Observatory which proved to have an important history. The discovery of new canals on Mars, *i. e.*, some never before seen, is nothing new, as some four hundred have been detected there in the last fifteen years. The present canals were remarkable in being not only new to earth but new to Mars. This was proved by reference to the records kept of the observatory's observations since 1894. Not only had they never been recorded before, but examination showed that they were not due to any of the several causes which have been found there to affect the visibility of the canals, to wit: seasonal change, austral or boreal development, etc. They had therefore never existed previously but had just been formed. The importance of this discovery needs no comment, except that it was only made possible by the systematic, continuous research of fifteen years.

17. In the course of radial velocity work at Flagstaff, spectra of numerous stars in Scorpio, in Perseus and in Orion have been found to contain peculiarly sharp *H* and *K* calcium lines, which by their character and behavior seem to originate in inter-stellar space, according to Mr. Slipher.

18. At the Dominion Observatory, Ottawa, personal equation with the registering micrometer has been found to be not a negligible quantity. The paper by Mr. Stewart deals with the observations of 1908, giving the relative personal equations of the five observers engaged, and describing a short investigation into the causes underlying the phenomenon. In the case of the author there was found a tendency to set the movable wire always to the left of the star by a quantity in the neighborhood of a second of arc, depending on the magnitude; north stars at upper culmination would thus be observed too soon, others too late.

19. Apparent discrepancies in Professor Very's measures of the Lowell Observatory spectrograms of Mars and the moon, on which Professor Campbell has commented, are explained as due to the mode of reduction. In spite of minor variations, the mean readings for five plates gave for the extra intensification of little *a* in Mars in conventional units, a value nine times as great as the probable error. No greater accuracy than this is claimed, but the existence of water vapor in the atmosphere of Mars is believed to be demonstrated. The result is made possible by the superiority of Dr. Slipher's spectrograms.

Campbell's claim that Professor Very's result is due to a notable increase of *telluric* "*a*" which happened to coincide with the taking of the Mars spectrogram on *each* of five dates, is examined and rejected.

20. Simultaneous observations have been carried on with the two instruments mentioned in the title for the past five years; those for 1905–8 are available for this comparison, embracing 931 determinations. Confining our attention for the present to the larger deviations, we find the following results for the two instruments:

Both residuals 4 times the probable error, 2 (both like signs).

Both residuals 3 times the probable error, 9 (like signs, 8; unlike, 1).

Both residuals 2 times the probable error, 75 (like signs, 50; unlike, 25).

The preponderance of like signs seems to leave little doubt that anomalous fluctuations of very appreciable magnitude do occasionally take place.

21. Mr. Campbell gave a résumé of the visual

work on long-period variables begun at the observatory in 1889, when the list numbered seventeen stars, to the present time, when the list contains over three hundred; showing the progress that has been made in the methods of observing them.

The following members of Section A were elected as fellows: R. P. Baker, S. G. Barton, W. E. Brooke, Thos. Buck, Arthur Crathorne, R. T. Crawford, I. M. DeLong, C. E. Dimick, F. J. Dohmen, J. F. Downey, L. P. Eisenhart, J. C. Fields, B. F. Finkel, F. L. Griffin, A. G. Hall, C. N. Haskins, T. M. Holgate, J. I. Hutchinson, D. N. Lehmer, O. M. Leland, Wm. D. MacMillan, W. R. Marriott, C. N. Noble, J. A. Parkhurst, F. W. Reed, F. G. Reynolds, Charlotte A. Scott, A. W. Smith, R. M. Stewart, Joseph Swain. The section elected G. B. Halsted member of the council, E. R. Smith member of the sectional committee and H. W. Tyler member of the general committee. On recommendation of the sectional committee Professor E. H. Moore, Chicago University, was elected chairman of the section.

G. A. MILLER,
Secretary of Section A
UNIVERSITY OF ILLINOIS

SOCIETIES AND ACADEMIES

THE ANTHROPOLOGICAL SOCIETY OF WASHINGTON

THE 438th regular meeting of the society, held December 21, 1909, was devoted to a paper by Dr. I. M. Casanowicz on "The Alexander Legends in the Talmud and Midrash, with reference to Parallels in Greek and Assyrian Literature."

The passages in the rabbinical literature bearing on Alexander the Great may be divided into two sections: (1) those which refer to his relation to the Jews; (2) those which contain episodes of his expeditions and adventures.

The first part includes: (1) Alexander's meeting with the Jewish high priest. At the instigation of the Samaritans Alexander ordered the temple of Jerusalem to be destroyed; but being met by a procession of Jerusalem nobles, headed by the high priest, in whom he recognized the apparition which had walked before him in his victorious campaigns, he revoked the order and delivered the Samaritans into the power of the Jews. (2) The suits brought by several nations against the Jews before Alexander. The Canaanites brought action for the possession of the land of Canaan, as it admittedly was originally their fathers'. They were answered that as Canaan was the servant of Shem he and his possessions were the property of his master. The Egyptians claimed back the gold and silver of which the Israelites despoiled them at the exodus. They were met by the counter claim of the wages for the service of the Israelites for four hundred and thirty years.

The second part embraces the following episodes: (1) Alexander's dialogue with the sages of the South. He addressed to them ten questions on cosmogonic and moral subjects, as: What was created first? Who is to be called wise? Who strong? Who rich? etc. (2) Alexander's penetrating into the land of the Amazons. They ward off his attack by suggesting to him that there will be little glory for him if he killed them, being women, but that he will make himself eternally ridiculous should he be killed by them. (3) Alexander's visit to Qaçia. There he witnesses a suit before the king in which both litigants disclaim the ownership of a treasure. The king advises them to marry their children and give them the find. Alexander said he would have put the litigants to death and confiscated the treasure. The king of Qaçia declared that if rain falls and the sun shines in Alexander's country it must be on account of the animals, for the men did not deserve these boons. (4) Alexander's experience at the gates of Paradise. He was there refused admission but given as a token a ball. He weighed against it all his gold and silver, but could not counterbalance it. The rabbis put a little dust upon the ball and the scale in which it was immediately went up. They explained to him that it was the eyeball of a man who was never satisfied. (5) Alexander's ascent into the air. He rose up in the air until the world appeared to him like a bowl and the sea like a chalice. (6) Alexander's descent into the depth of the sea. He caused some of his men to dive into the ocean in glass chests. When returned to the surface they reported to have heard the ocean sing: "The Lord is mighty on high."

Most of these narratives are also found in the Greek compilation of the Alexander legends known by the name of Pseudo-Callisthenes, where they are embellished with many accessory details and otherwise much modified. The episodes of Alexander's adventure at the gates of Paradise or, as in the Greek account, the fountain of life, and his ascent into the air also suggest parallels in the Assyro-Babylonian literature; the first in the Nimrod Epic, the second in the Etana legends. There is a great resemblance between the rab-

binical and Greek accounts, pointing to a relationship between both. But the points of contact between the Assyro-Babylonian account, on the one hand, and the stories in Pseudo-Callisthenes and the Talmud on the other, are too vague and of a too general character to warrant the assumption of a direct relationship between them.

At the 439th meeting, January 4, 1910, Dr. Aleš Hrdlička, of the National Museum, exhibited a cast of the lower jaw of *Homo heidelbergensis* donated recently to the National Museum by Professor Schoettensack, of Heidelberg University. This jaw, which is preserved at the university and has been described in detail by Professor Schoettensack, was found less than two years ago near the village of Mauer, 10 kilometers southeast of Heidelberg, under nearly 75 feet of loess and ancient river sand. It dates from the Upper Pliocene or the very beginning of the Quaternary period and represents the most ancient being known that can be regarded as man. To illustrate the remarkable characteristics of this jaw Dr. Hrdlička showed a number of mandibula of different anthropoid apes along with those of recent man. The paper was discussed by Messrs. Theodore Gill, G. M. Kober, D. S. Lamb, Daniel Folkmar and others.

The remainder of the evening was devoted to an address by Dr. W J McGee, on "Conservation in the Human Realm." The speaker said that the human realm may best be defined in terms of relation to the other great realms in nature; and these are most conveniently stated in the order of increasing complexity, which may be considered also the order of sequence in cosmic development.

The initial realm is that pertaining to cosmic bodies and their interrelations; the fundamental principle comprises the actions and reactions of gravity, impact, etc., which together have been denoted molarity; the field is largely covered by astronomy, with a part of physics. The second realm pertains to atomic and certain molecular interrelations; its fundamental principle is affinity; and its field coincides fairly with chemistry. The third realm is that of organic activity; its principle is vitality, which directly and indirectly accelerated and multiplied the chemical differentiation of the earth-crust; its field is covered by a large part of biology, with cognate sciences. The fourth realm (which is closely allied to the preceding) pertains to those organisms so complete in themselves as to be self-active; its principle is motility; and its field is covered by zoology and allied branches of knowledge. The final realm is that in which motile organisms are so completely self-active as to react upon and dominate lower nature; its principle is mentality; and its field is anthropology in all of those aspects resting on a psychic basis. Now the entities proper to the several realms coexist and interact; and in general the entities of each higher realm dominate over all those of the lower realms. This is especially true of mentality, which employs motility and directs vitality to control affinity and molarity, thereby making conquest over lower nature for human welfare. In the power of mentality human strength lies, while danger also lurks; for the power may be, and in the absence of constraint often is, used for the destruction rather than mere subjection of the materials and forces of nature. Viewed broadly, the exercise of control over the realms of lower nature pertains to the human realm no less than do the more passive attributes of mankind.

When this nation was founded but two resources were recognized—the men, with the land they made their home. Half a century later coal mining and the practical manufacture of iron began, and in another half century the industrial exploitation of the forests. Yet statecraft lagged behind industry so far that these enormous values below and above the surface were alienated nominally as land, passed under monopolistic control, and were diverted from the whole people to which they rightfully belonged; while free citizenship largely gave place to industrial dependence. At first water was neglected as a mere appurtenance to land; and now that it is recognized as the primary resource—that on which life depends, so that it gives value to all the rest—it also is passing under a monopolistic control whereby all citizenship will tend to merge into industrial dependence on centralized power. The situation is one of the gravest ever confronted by any people in the world's history, graver than any ever survived by a nation; and it behooves those possessing the advantage of scientific training and knowledge of principles to give it earnest consideration—and to aid in defining the interrelated duties of the individual, the family and the state in ways tending toward the perpetuity of our people.

A lengthy discussion of this paper closed the meeting.

John R. Swanton,
Secretary